An Investigation into the conditions of Science Laboratories in the Higher Secondary Schools of V.P. Region.

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By

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CHAPTER I

INTRODUCTION.

Science occupies the most important place in the field of education. The environment in which we are living to-day is predominantly coloured by science and future is expected to be all the more colourful in the context of Science. Science itself is more than material progress. It involves a thorough search after knowledge. The knowledge can best be achieved by careful study of observations and designing of experiments to test ideas and the conclusions arrived at due to theoretical study and observations, forming a habit of strict accuracy. Keeping in view the above stated necessities regarding scientific progress, aims of teaching science at the higher secondary stage have been formulated.

Aims of teaching science at Higher Secondary stage.

Higher Secondary Education in our country is particularly meant for the children of the age group (14-17) years as recommended by Mudaliar Commission, Report 1953. So the purpose of science teaching at this stage should be to meet the needs of adolescents in various aspects of life.

The statements are organised under the major aspects of living as follows:-

*" 1. Meeting the needs of adolescents in the area of personal living.

2. Meeting the needs of adolescents in immediate person social relationships.

3. Meeting the needs of adolescents in immediate social civic relationships.

4. Meeting the needs of adolescents in economic relationships.

5. "Encouraging reflective thinking."

Educational values of Science:-

Science has specific applications in many of our life activities and situations. Science with regard to these activities serves to bring out Practical, Cultural and Disciplinary values in life.

Practical values of Science:-

Science has captured every field of human activities. It has got its operation in the working of business, education and all other professional activities.

Cultural Values of Science:-

In order to understand the environment, one has to base his knowledge on scientific foundation upon which the environment is built.

Disciplinary Values of Science:-

The disciplinary values of Science which are derived from the study of any science subject, are the values and trainings which may be transferred to other fields of practical working. The scientific method has extended to almost every area of human activity. It has been largely responsible for the progress achieved in the fields like medicine, industry etc.

Now in-order to achieve these educational values of science an analysis of aims of teaching science has been made by Wilbur Beauchamp in Instruction in science which holds true for entire programme of science teaching in the secondary - school. These aims and objectives are classified under the following six heads:-

A. Knowledge

B. Exploration

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* Science Teaching by Keff page 46.

C. Abilities, I. To think scientifically.

II. To use scientific instruments common in the laboratory.

D. Attitudes.

E. Ideals and Habits.

F. Interests.

So each and every unit in the teaching of science should minister to these specified aims and objectives.

Important Characteristics of Dynamic methods of teaching Science subjedts:.

In the pamphelets second National Science Day 1962, issued by the department of extension services M.P. Jabalpur, it has been emphasised that the teaching of science in our schools needs to be thoroughly over hauled and reoriented. It has been expressed in the following words:-

" It would not be sufficient for our students to be merely acquainted with the contents of a given science curriculum. They should have opportunities to develop abilities, such as critical thinking, sound judgement, creativity and originality which should guide them in their approach to every day problems. They should also acquire manipulative skills, purposeful - observation and a Scientific attitude, to be applied to all important phases of life."

To meet the above requirements, our teaching of science through dynamic methods has to be oriented,to the achievements of its objectives so that pupils may develop all the desirable abilities as a result of the education they receive in the school. Any such achievement would naturally depend on what opportunities and facilities we create for our pupils.

No doubt there is no single method which embodies all the

characteristics of Dynamism of teaching but most of the methods to some degree or other provide for the development of creative activity of the child.

Any method of teaching science, if it is to be practised effectively, must have laboratory as a basis for success. Practical work in science occupies the central position for all the methods.

As a matter of fact, on one extremity there is Lecture method in which the creativity of the students is totally vanished and at the other extremity, there is laboratory plan which mainly depends upon practical work and ~~originalityxxx~~ originality of ideas, in which factual knowledge has little importance. Therefore, the aim should be to follow a method in between the two extremities.

Any way, Laboratory work has its own place in the teaching of science subjects. Its importance in words of Mr. Neff is given below:-

" The individual laboratory work whereby every pupil participates in experimentation and first hand experiences ~~whix~~ with materials and equipment is considered to be justified in secondary school science. Individual laboratory work produces certain results in the pupil more permanently than does the demonstration."

Prior to the reorganisation of secondary education in our country, the teaching of science was mostly based on lectures and discussions. Not only in our country, in the countries like U.S.A. too, the instructional materials were encyclopedic in character and very fragmentary.

Secondary Education Commission has laid its emphasis on dynamic methods, the Chief characteristic of which is that

pupils are to be an active participants in the instructional programme. Laboratory instruction has become very popular in the present era of science teaching. To-day stress is being laid on inductive method of teaching which includes the presentation of instructional materials in the form of problems.

Methods based on rote learning and memorization are being discouraged today. Experimentation, Demonstration and illustration, are chief characteristics of dynamic methods.

Various methods are being practised in order to carry out the successful teaching of science. These methods may be enumerated as below:-

1. The United Methods
2. Question and Answer Method.
3. The Reference Method.
4. The Contract Method.
5. The assignment method.
6. The project method.
7. The Heuristic Method.
8. The Laboratory Method.
9. The Demonstration Method.
10. The Concentric Method.
11. The Inductive and Deductive Method.

Place of Laboraties in the teaching of Science subjects:-

Any method of teaching science, how so ever effective, can not be implemented so long as proper facilities and equipments are not available for it. Science, on account of its practical work and demonstration, has got an unique place in the curriculum of schools. This uniqueness also results from the variety of materials and experiments necessary for its effective teaching. Most other subjects can be learnt if ordinary tools are available, such as pencil, paper, blackboards, text books and a few supplementary aids. These are also essential for the teaching of science, but if they are the only tools, science becomes a dull and un-interesting subject.

If it is to be learnt effectively the subject matter of

science must be experienced. Good science teaching must be based on observation and experiment. There can be no substitute for these. But performing experiments and learning to make close observations, require special facilities and these are lacking at present, specially at the secondary stage. As a result, science teaching suffers a severe handicap in these regions.

Under the circumstance noted above laboratories play the most important role in the teaching of science. The teaching of any branch of science can only be effective in its true sense, if it is followed by thorough practical work by individual students and demonstration work by the teachers of science. Importance of practical work in science has also been emphasised by a body of his majesty's Inspectors of Englan in the following words:-

*"It would be unsatisfactory if the pupil's practical work came to be limited to the demonstration of known principles by methods in whose design they had no part. Full value from investigation in-to unknown problems will be achievable only if pupils have reached a stage when they are able to appreciate what is in volved in the planning of an experiment".

As already discussed, students of science are expected not only to have factual and theoretical knowledge of certain principles.*" They should be sufficiently familiar with ordinary scientific investigations, the necessity for controls and the degree of accuracy required in each measurement to achieve the purpose in mind, and they should have had practice in formulating an argument based upon observation."

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* Science in Secondary Schools, Ministry of Education, London, Page 72.

Thus it becomes evident that scientific studies can not be properly prosecuted in the absence of well equipped and maintained science laboratories.

Necessity for the Investigation:-

The problem of well equipped laboratories is of far reachin importance during these days of scientific developments. Nothing substantial can be achieved, if the higher secondary schools are not provided with proper laboratory facilities in all its aspects. As a matter of fact I feel that no serious attention has been given to this aspect of requirements of science teachin for want of proper explanation of labortory conditions in our region.

I was fortunate enough to see the science laboratories of a few institutions in our region during the course of conducting the practical examination and found that standards of performance of students differed from place to place. Students can not be held solely responsible for it. Since then I had a desire to investigate in to this field of practical work and the opportunity came when I joined the University as a private candidate for M.Ed.Examination.

Therefore, I have taken up the opportunity to make a survey of existing laboratories and there by brining out some suggestions for their improvement. I can not be definite about the extent, I have been able to solve the problem in hand but from sincere efforts, I can only presume that it may give some momentum to the cause of science teaching in Higher - Secondary Schools of this region.

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C H A P T E R - II

The Problem, Plan and Procedure.

In the first chpter discussion about the importance of laboratories in the teaching of science has been given. An attempt has also been made to give a general view of the existing science laboratories together with the aims and objectives to be achieved through the teaching of science at the High Secondary stage. Now in this chapter the problem in hand will be discussed alongwith the plan and procedure that has been followed in taking up the study.

Problem and its meaning:-

The problem that has been taken up for study is " An investigation in to the conditions of science laboratories in the Higher Secondary Schools of V.P.Region."

The development of Higher Secondary Education in Madhya Pradesh in general and in Vindhya Pradesh Region in particular is going on very repidly. Along with the General Education, Science Education is also being given its due recognition. As a teacher of science in this region for a period of eight years, I experienced that the conditions of science laboratories are not satisfactory. This period is a sort of transitional period when number of Higher Secondary Schools is increasing day by day. A number of Junior High Schools are directly being raised to Higher Secondary Status having no consideration for teaching facilities available over there. Under the circumstances noted above this work of an exploratory nature has been taken up.

Before entering in to the plan and procedure adopted, it will be better to give the jurisdiction of my approach and also an explanation of the terms used.

The word science laboratories stands here for the laboratories of three science subjects i.e. Physics, Chemistry and Biology,.The conditions have been surveyed mostly in general and not in particular for a particular subject. Of course chief characterestics of laboratories of different subjects have been given due weight in the study.

Now the jurisdiction of my field of work extends to seven districts of V.P.Region, as noted below:-

1. Chhatarpur.
2. Tikamgarh.
3. Panna.
4. Satna.
5. Rewa.
6. Sidhi
7. Shahdol.

Formerly district Datia was also included in V.P.Region but recently that district has been transferred to Gwalior ~~region~~ region in matters of education, hence that has not been approached.

Plan :-

My efforts have been to tackle the problem scientifically as for as possible. Scientific approach to some problem consists of the following steps.

1. Making an accurate survey of the problem.
2. Collecting data regarding the problem.
3. Drawing conclusions from the data collected.

Therefore, the problem has been discussed from the following points of view.

1. A general survey of science laboraties with regard to their various aspects has been made.

2. Datas have been collected from the jurisdication under study.

3. Conclusions have been drawn on the interpretation of the datas collected.

Mostly conclusions are in the form of problems in the teaching of sciance confronted by science lecturers and teachers

4. On the basis of the conclusions drawn by interpreting the collected datas, some suggestions regarding improvement in the conditions of sciance Laboratories have been given. It has always been kept in view that the suggestions given are in conformity with sound educational practices used for the teaching of science.

Procedure:-

Following means have been adopted ~~together~~ to gather information on the various aspects of the problem.

1. Questionnaires.

II. Personal observations by visiting certain laboratories.

III. Study of Relevant Literature.

Since the time at the disposal was short, it was decided to gather information on the various aspects of the problem mainly with the help of a questionnaire. In preparing the questionnaire , consideration was given to the language and construction of the questions. Care was taken that questions were constructed in clear language and that they were arranged in appropriate sections and designed in a way to provide maximum convenience to readers.

Questionnaires were served to 75 institutions of the seven districts. Care was taken that the representative sample may not be a biased one, questionnairs were distributed to urban, rural, Govt., Non govt., Boys and Girls Schools. Further, One more point was considered while serving the questionnaires, that the old as well the new institutions, both may have due representation in the sample. This is, what can be said about the reliability and validity of my work.

Table given below gives a clear picture of the questionnairs returns.

TABLE NO. 1

No. of questionnaires served.	No. of questionnairs returned.	Percentage of Return.
75	44	58%

TABLE No. 2.
TABLE SHOWING THE DISTRICT WISE RETURN OF QUESTIONNARIRES.

S.N.	Name of District.	No. of Returns.
1.	Chhatarpur	9
2.	Panna	6
3.	Satna	6
4.	Rewa	8
5.	Sidhi	3
6.	Shahdol	6
7.	Tikamgarh	6

Personal Observations:-

In order to supplement the informations obtained through questionnaires and to obtain clarification on the various issues,

Personal visits to laboratories of certain instituions were needed. As such, I personally visited a few institutions with regard to science laboratories. It was tried that visits may be uniformly distributed in the region and therefore all types of schools were visited. Among these schools, there were, Rural, Urban, Boys, Girls, Govt. and Non Govt. Institutions. In total laboratories of eleven schools were visited. Only eleven schools were visited because of shortage of time at disposal.

Study of Relevant Literature:-

As a matter of fact very little work has been done in this aspect of science teaching in our region. Relevant literature regarding the problem could be available in a very limited quantity. The investigator made a correspondence with the following authorities in order to know some thing about the study of science laboratories, if it has been done so far in our country in general and in our region in particular.

1. Science consultant to Director of Public Instruction, M.P.,Bhopal.
2. Directorate of Extension-Service, Programme for Secondary Education, Govt.of India, New Delhi.
3. Assistant Director of Public Instruction, Rewa.
4. Her Majesty's Stationary Office, London.

No reply could be received from the authority quoted at serial one and three above. From the other two sources some references were made for study about the problem in hand. As suggested, references were consulted and the mention about them has been made at the proper places. It appeared to me that literature relating laboratory provision, so far produced in our country is limited. Any way, the intake of what ever

meagre literature was available has been incorporated in the work.

Through out this work, discussion is based on the information collected through questionnaires. The reliability of the facts is to be taken within the limits of the questionnaire methods of the work. In the discussion where actual numbers are quoted, they refer to this sample only and in view of its small size they should be treated with due caution.

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PART - II

CHAPTER - III

Teaching practices in Science subjects.

In the second chapter a discussion about the meaning of the problem and its plan and procedure has been given. Now in this Chapter syllabus requirement, teacher's limitations and also provision for practical work and demonstration work in the teaching methods will be dealt.

Syllabus requirement:-

The teaching of science in the Higher Secondary Schools of this region is being directed by a prescribed syllabus of Madhya Pradesh Board of Secondary Education, Bhopal. The courses in Physics, Chemistry and Biology include teaching in theory and practical both. It has been made compulsory to pass in theory and practical both seperately. Practical examinations in science subjects have got a very important place. External examiners are appointed by the board to conduct the practical examinations. Students have to keep a record of the experiments performed in IX, X and XI classes and this record has a fixed percentage of marks in the marks allotted for practical examination.

The scheme of the board is that practical work must be distributed uniformly through out a period of 3 years. Separate number of experiments to be completed in a perticular class has been fixed up in the syllabus. A list of experiments has also been given for every class and for every year. The experiments prescribed in Physics, Chemistry and Biology are based on the full theory course prescribed for 3 years.

Teacher's limitations:-

The whole work of teaching science centres round the teachers of science who are finally responsible for a successful implementation of the scheme of the Board. Teachers do their best to complete theory and practical course prescribed for every class. But as already discussed in the first chapter that science is unique as a subject with regard to its equipment and special facilities required for its teaching. So teachers of science have to encounter a number of difficulties in meeting the prescribed goal. So far as the teaching of theory is concerned, that may be carried on ordinarily in any room of the school and also without any special facility. But as soon as there stands out the question of practical work, a number of facilities are immediately needed for the work.

Practical work requires a suitable laboratory building for every subject where in students may do their practical work. Along with the building and furniture, the requirements of suitable apperatuses, chemicals and other items are also very essential. This teacher has got many limitations for discharging his duties of teaching science satisfactorily.

Some times his work is handicapped because of poor provisions of building and furniture and some times because of poor equipment of apperatuses and other necessities.

More over, teachers of science are overworked with so many other activities required for the conduct of the laboratory, thus purchasing of equipment, maintaining all the laboratory records, setting up the demonstration apparatuses and also the apparatuses for the individual practical work. He has to guide the students during the course of practical work. He has also to check the

practical record of the students. It is essential that teachers of science should be provided with the assistance of some skilled and trained hands.

If the ideal conditions of the syllabus requirements are to be met in full, ideal facilities may also be provided.

Provision for the practical work and demonstration work in the teaching of science subjects:-

Every subject of science has its direct relationship with the demonstration work by the teacher and practical work by individual student.

Therefore, teaching of science in schools must be adjusted keeping in view the above necessities of science teaching. The time table of the school must have provision for practical work in every science subject and in every class. As a matter of fact time table is not ~~/~~ framed keeping this fact in view and science teachers are badly hindered.

Every topic in science subject while being taught is to be followed by a suitable demonstration. As already discussed in chapter I, the dynamic methods of science teaching are based on demonstration and practical work.

In this way it is concluded that facilities required for the teaching of science must be provided in the Higher Secondary Schools.

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CHAPTER - IV.

LABORATORY CONDITIONS AND PROBLEMS

In the previous chapters importance of practical and Demonstration work in the teaching of science has been discussed. It has also been discussed as to what part laboratories play in the teaching of science subjects. Now in this chapter an analysis of the existing conditions of science laboratories in our region has been discussed.

The aims of teaching science can not be fulfilled till the facilities of well equipped and maintained laboratories are not available in the Higher Secondary Schools. Syllabus requirements, if they are to be met in full, also require the provision of well equipped laboratories.

During these days a rapid expansion of education is going on through out the region. New Higher Secondary Schools are being opened. It appears to be the policy of the Govt. of M.P. to provide science recognition to nearly all the Higher Secondary Schools of the region.

In order to know, how far the recognition of science subjects in the schools under consideration is justified, a question was included in the questionnaire as given below.

Question:- In ~~nut~~ what respects, the recognition of science courses in your school is justified ?.

(a) There is sufficient number of students offering this group.

(b) You have sufficient number of qualified Lecturers & teachers.

(c) You have well equipped & maintained laboratories for science subjects.

An analysis of the responses received is given in the table below.

TABLE NO.1

S.No.	Respects in which recognition is justified.	No.of schools giving positive reply.	Percentage
1.	Sufficient number of students.	30	68.1
2.	Sufficient number of Lecturers & Teachers	21	47.7
3.	Well equipped and maintained laboratories	6	13.6

From the table given above following interpretations can be made.

1. In the sample, 68% of the schools are having sufficient number of students offering science group. This shows that there is a development of a ~~t~~ tendency to learn science. These schools are from urban as well as rural areas.

2. The provision of the teaching staff is not very ~~satisfactory~~ satisfactory as becomes clear from the percentage column. The institutions having sufficient number of ~~xxxx~~ students offering science subjects should be compulsorily equipped with suitable staff for the same.

3. So far as the question of well equipped and maintained laboratories is concerned, the percentage is considerably low. The success of science teaching if it is to fulfil its aims and objectives, mainly depends on its practical value in life. In case our students could not have thorough practical knowledge of scientific principles and theories they read, the mission of

science teaching at the Higher Secondary stage would prove an utter failure. Therefore provision of well equipped laboratories should be made.

Laboratory Building:

The discussion about the place of laboratories in the teaching of science has already been given in the previous chapters. The study of the laboratories is to be made with regard to their various aspects. The first and the most important aspect for a science laboratory is that of a suitable building fulfilling all its requirements.

Science teaching can not be carried on efficiently till there is no sufficient accommodation to conduct the practicals. As a matter of fact a laboratory may have all the necessary science material, like chemicals and apparatuses but if there is no room for the storage of all these items, they will all go a waste and nothing else.

Therefore, with a view to having an idea of laboratory building in different schools, a question was included in the questionnaire to this effect.

Question: What is the nature of laboratory provision for science in your school ?.

Separate	Combined
1.Physics	1. All the three
2.Chemistry	2. Physics & Chemistry
3.Biology	3. Physics and Biology
	4. Chemistry and Biology

Responses received in this connection are tabulated below:-

TABLE NO.2

S.N.	Nature of provision	No.of Schools.	Percentage.
1.	Having separate laboratories.	12	27.2
2.	Having three combined Laboratories.	9	20.4
3.	Having two combined Laboratories.	23	52.4

Analysis regarding type of combination has not been given as it directly does not concern the problem.

The schools having separate laboratories may not be facing an acute problem regarding accommodation for the practical work and for storage of the material but the conditions of those having two or three laboratories combined, are of a grave concern. Though the percentage of schools having three laboratories combined is not appreciably high, yet the problem is important considering the effect of shortage of accommodation on science teaching.

Out of these institutions having combined type of laboratories in the sample nearly 50% are having recognition in scinnce subjects in High School Classes for a period of more than 5 years and in Higher Secondary Classes for two years. Prior to the merger of Vindhya Pradesh into Madhya Pradesh, this region was in the jurisdiction of Ajmer Board which prescribed practical examination in Science for High School also. Therefore,

it becomes all the more important to think, how these institutions would have met the standard of achievements in the practical work since then.

These schools are having IX, X and XI classes for science study. Under the shortage of accommodation, of course, the teachers must be facing problems in arranging the practical work on right lines. When there is combined laboratory for two or three subjects, arrangement of the practical work in time-table will be a problem for the school. In order to know the exact nature of problems arising out of this combined type arrangement of laboratories , a question was included in the questionnaire. This question is in continuation to the previous question about nature of laboratory provision.

Question:- If combined what difficulties do you face becasue of this arrangement ?.

(1) Practical work of your subject suffers.

(2) Maintenance of apparatuses becomes difficult.

(3) Arrangement of practical work in time table becomes difficult.

The response of this question has been given by the science Lecturers and teachers of all the schools having combined type of laboratories. They are of the opinion that not only the arrangement of practical periods in time table becomes difficult due to shortage of space rather the practical work of every subject suffers badly. Out of 44 laboratories of the region included in the representative sample 33 are of the combined type i.e. 75% of the sample. Some of the Lecturers & teachers are of the opinion that due to this shortage of accommodation mostly there becomes an over lapping in the time table.

In order to know the exact situation of the practical work being done in these combined type of laboratories, a question was included in the questionnaire.

Question:- What system have you adopted in your school for the conduct of the practical work in your subject ?.

(a) All the three classes IX, X and XI do the practical work.

(b) Only the final class does the practical work.

(c) Practical work is done in vacations or at the end of the sessions.

(d) Practical work is done after school hours.

It is found from the responses that the efficiency in the conduct of the practical work is very low. It is found to be a general practice to get only a few selected experiments completed at the end of the session and that too in the final class. This lamentable state of affairs is of a grave concern when Higher Secondary Syllabus is being followed in science through out the region.

The board of secondary education, M.P. has prescribed a number of practical experiments in Physics, Chemistry and Biology in IX, X and XI classes. This practical work is expected to be uniformly distributed through out the 3 years of Higher Secondary stage but the reality is other wise.

The investigator as already stated personally visited 11 laboratories. During this period some practical Note Books of students were also checked. It was found that on average two or three experiments were noted by them in the Practical Record after a period of three years. No practicals are conducted in IX& X Class and only the final class does the practical work. Thus practical work is found to be only a nominal one.

Responses given in reply to the above question are tabulated below:-

TABLE NO. 3

S.No.	System adopted for practical work.	No. of Schools.	Percentage.
1.	All the three classes do the practical work.	9	20.4
2.	Only the final class does the practical work.	35	79.5
3.	Practical work is done		
	(i) In vacations-	3	6.8
	(ii) At the end of the Session	25	57
4.	Practical work is done after school hours.	25	57

From table no.2 it was found that 12 schools are reported to have three separate laboratories and from the table given above it is found that there are only Nine schools where IX, X and XI, all the three classes do the practical work. Even in all the schools having the provision of 3 seperate laboratories, practical work is not uniformly distributed over three years.

There are few institutions which have adopted batch system for the practical work. But the teachers of these schools have expressed during my personal visits that they are over - burdened due to this batch system. Batch system is suitable for the school where number of students may be more than 60 or so, so that teacher's labour may be put to the maximum benefit.

But the number of students offering science group is not so very large in the schools adopting batch system. A question was included in the questionnaire in order to know the number of students offering science subjects which may be seen from the table given below:-

TABLE NO. 4

S.No.	No. of students in IX, X, XI combined offering science group.	No. of ~~students~~ schools.
1.	Above 100	6
2.	Between 50 and 100	21
3.	Below 50	17

So far as the suitability of batch system is concerned, it is quite good for the schools having large number of students. Above 6 schools having the number of students above 100 are the schools of district head quarters. This strength has been calculated combining the three classes. The note worthy feature in this respect is that even the schools having 10 as the no. of students in one class, have adopted the system of batches in that class. So it is clear that there are schools even not having so much accommodation that 10 students at a time may work smoothly. Keeping in view the above noted facts, it is realised that the problem of laboratory building is very acute in this region.

Recently, an information was gathered by the Assistant Director of Public Instruction, Rewa regarding existence of Science Block in various schools of the region. I approached that office in order to know the actual condition of science

laboratories. By the time I reached there information from 50 schools were received and none of them showed the existence of a separate science block.

No doubt, Govt. of M.P. is paying its considerate ~~extent~~ attention towards science education. Recently heavy grant has been given to Maharaja Multipurpose Higher Secondary School, Chhatarpur for the construction of two separate science blocks. As a matter of fact existance of a separate science block for every school providing science instructions is essential.

Laboratory Building for science subjects is not only limited to the single room laboratory. Every laboratory building over and above the practical room must have lecture room, store room etc. attached with it. In order to know the conditions of science laboratories in this respect a question was included in the questionnaire as given below.

Question: What is the nature of accommodation in laboratories of your school ?.

S.No.	Physics Lab.	Chemistry Lab.	Biology Lab.
1.	Practical room	Practical room	Practical room
2.	Lecture room	Lecture room	Lecture room
3.	Demonstration hall	Demonstration hall	Demonstration hall
4.	Dark room	Preparation room	Botanical Garden
5.	Store room	Store room	Frogary
6.	Staff room	Staff room	Staff room
7.		Balance room	

An analysis of these provisions attached with Physics laboratories is given ~~below~~ on the next page.

Physics Lab. **TABLE NO. 5.**

S.N.	Nature of provision.	No. of Laboratories provided with.	Percentage
1.	Practical Room	44	100
2.	Lecture Room	12	27
3.	Demonstration Hall	4	12
4.	Dark Room	5	11
5.	Store Room	9	20
6.	Staff Room	5	11

For the successful teaching of science every physics Laboratory must be provided with these attachments.

Practical Room:-

The first requirement of a physics Laboratory is practical room. All the schools in the sample are provided with a practical room for Physics. But during my visits to certain laboratories, I found that these practical rooms are not of standard size. Mostly class rooms of the schools have been converted in to the practical room. Such practical rooms do not fulfill the standard requirements.

Lecture Room:-

Only 27% of the schools in the sample are having separate Lecture Room. Other schools have no provision of separate lecture room for science. In my visit to Maharaja Multipurpose Higher Secondary School,Chhatarpur, I found the provision of a stair type lecture hall. Such lecture Halls are quite good for the teaching of science. As the demonstrations given by the teacher are easily visible by all the students. The strength of the students in the schools having lecture room is between 50 and 100.Provision of separate lecture room is not so essential for every school, but atleast there must be a class room used exclusively for the teaching of science.

Demonstration Hall:-

The provision of Demonstration Hall is available in only 4 schools of the sample. Mostely Demonstration work is carried on by the teachers in the Lecture Room or in the practical room. As a matter of fact practical room is used nearly for all the purposes.

Dark Room:-

Provision of dark room in a Physics Laboratory is very essential. There are experiments prescribed by the Board of Secondary Education, Madhya Pradesh which can be performed successfully only in dark rooms. Only 11% schools in the sample are provided with dark rooms. In certain schools teachers have made the provision of a dark room by surrounding some spaced with some cloth curtains. This serves the purpose of the dark room to some extent. Experiments on light like determination of focal length by displacement method can best be performed in dark rooms. The provision of dark room for every science laboratory is not very important but atleast there must be one dark room to be used for different science subjects whenever required.

Store Room:-

The provision of a separate store room in any science ~~X~~ laboratory is most essential. But the true state of affairs is that only 20% schools of the sample are provided with a separate store room. In the absence of a store room, the proper care of apperatuses becomes difficult.

Higher Secondary Schools are expected to have costly apparatuses of physics. In case there is no provision of a separate store room, there is possibility of breakage of apparatuses as well as of being stolen. In order to know the difficulties faced by the teachers in absence of these above

noted provisions, a question was included in the questionnaire which will be discussed after a survey of laboratories in other respects.

Staff Room:-

Teachers after teaching two or three periods require some rest in their vacant periods to refresh themselves, 11% schools are provided with staff room.

In most of the schools, as I noted during my visits, are having staff rooms in common for all the departments. But the provision of atleast one staff room for science department as a whole is necessary so that science teachers may safe their time in going at a distant staff room for rest.

Chemistry Laboratory:-

On analysing the provisions made, it is found that most of the provisions noted above are in common for physics, Chemistry and Biology subjects. Therefore, no separate table is given here for Chemistry Lab. The provisions required particularly for Chemistry Laboratory are discussed here.

Balance Room:-

Higher Secondary syllabus had prescribed the performance of single and Double titration by Higher Secondary students. For a complete knowledge of titration, it is essential that stuents must have a thorough practice of weighing. Accurate weighing in chemistry Analytidal work is more essential than in any other subject. Therefore, separate provision of Balance Room is quite essential. More over, Analytical chemical Balances are very costly having their prices between Rs. 500/- to Rs. 2,000/-. If these balances are not kept safe they will loose their efficiency due to mishandling by the students and others.

In the sample it is found that only 11% schools are

provided with a separate Balance Room.

Store Room and Preparation Room:-

Only in 15% schools of the sample there is provision of store room. There is no provision of separate preparation room in these schools. Though, the provision of a separate store room in chemistry lab. is more important than other laboratories. In Chemistry there are various chemicals having their different properties. Some of them are highly poisonous. In case chemicals are lying loose in the practical room, there is every danger from the students for the mis-use of chemicals. They are not familier with the properties of all the chemicals. Therefore, separate provision of store room in a chemistry lab. is all the more essential. Designing of a chemistry store room requires special attention on account of the storage of Acids etc.

During my visits to laboratories, I found that provision of store room for physics and chemistry is common. But this common arrangement for store room is not favourable. Metallic apperatus of physics may be affected by chemicals and may be spoiled. Therefore separate provision for physics and chemistry store room is more essential.

Biology Lab:-

The Biology Lab. requires some special provisions alongwith the provisions common to physics and chemistry laboratories. Botanical Garden and Frogary are the special features of Biologica laboratory. But there are 20% Biological Laboratories in the sample which have the provision of Botanical garden out of which only five percent are having the provision of both.

Practical work in Biology does not depend so much upon apparatuses and chemicals as upon the flowers, leaves and stems etc. in botany and on frogs and birds etc. in zoology.

Therefore the provision of botanical garden and fregary for the practical work in biology is essential.

In this way a general survey of physics, chemistry and biology laboratory with regard to building provision has been done. It is concluded from the informations gathered that the building provision for science laboratories is not upto the mark in the Higher Secondary Schools of this region.

A question was included in the questionnaire to know if the present provision of building is sufficient for the practical work.

Question:- Is the present provision of building sufficient to conduct practial conveniently ? Yes/ No

Lectures and teachers of all the institutions have expressed that the provision of building is not sufficient. Even the schools having the number of science students in IX, X and XI in total below 50, have said that accommodation is not sufficient for practical. In the personal interviews with the lecturers and teachers, investigator found that in some of the schools teachers do not want to take pains to have maximum benefit with the available accommodation.

Situation of Laboratory Building:-

One of the most important aspect for the science laboratories is their situation in the school. In order to know the situations of laboratories a question was included in the questionnaire.

Question:- What is the situation of Laboratory building ?.

(a) A separate Laboratory.

(b) Part of the main building but at one end of it.

(c) Part of the main building but surrounded by other class rooms.

The responses are tabulated on the next page.

TABLE No.6

S.No.	Situation of Lab. Building	No.of Schools	Percentage.
1.	A separate Lab.	6	13.6
2.	Part of the main building but at one end of it.	20	45.4
3.	Part of the main building but surrounded by other Class rooms.	18	40.9

A large number of science laboratories are part of the main building. As a matter of fact there is no separate existence of a science block in the schools of this region. 40% laboratories are surrounded by other class rooms. It is better if such laboratories are shifted at one corner of the school.

Furniture and other provisions:-

In order to have effective science teaching provision of furniture in science laboratories is most essential. Special type of furniture is required for science laboratories as ordinary common tables, chairs or desks can not solve the purpose.

A question was included in the questionnaire to have an idea of the type of furniture provided.

Question:- Do the tables in your laboratory satisfy the standard requirement of well furnished laboratory tables ?. Yes/ No

All the schools are of the opinion that the tables in their laboratories do not fulfill the standard requirements. Even the schools of district headquarters are not having the tables of standard size in their laboratories.

If the syllabus of Board of Secondary Education, Madhya Pradesh be taken into consideration, tables provided in this chemistry laboratories must have all other facilities to meet the syllabus requirements.

Chemistry tables should be fitted with Gas-Burners, Shelves, racks and sinks and water taps etc. In order to know the exact nature of provision of furniture in chemistry laboratories a question was included in the questionnaire in continuation with the above question.

Question:- If not, what are the short comings ?

(a) Shelves and racks (b) Water taps (c) sinks

(d) Gas Burners (e) Others.

The position of laboratories in this respect becomes clear from the following table.

TABLE No.7

S.N.	Nature of short Comings	No.of schools having the short comings.
1.	Shelves and racks	42
2.	Water Taps	42
3.	Sinks	42
4.	Gas Burners	44

There are two institutions in this sample where chemistry tables are fitted with shelves, and racks. These schools are Maharaja Multipurpose Higher Secondary School, Chhatarpur and Martand Multi-purpose Higher Secondary School, Rewa. But even these institutions have not got these tables fitted in the building as yet. During my

personnal interview with the lecturers of ~~Higher Secondary School~~ Higher Secondary School, Chhatarpur, I was told that the building of newly constructed laboratory is on P.W.D. books and P.W.D., authorities do not allow to have any type of fitting in their buildings.

Facility of water taps can certainly be not available at all the places. Only two District Higher Secondary Schools have ~~xx~~ got the provision of water taps and sinks.

Now the problem of storage of chemicals and apparatuses is also of considerable importance. For the storage of material schools are having Almirahas and wall cup-boards. Nearly all the schools under consideration are having a good number of Almirahas and also wall cup-boards in physics, Chemistry and Biology Laboratories. Lecturers and teachers have expressed that the number of Almirahas and wall cup-boards is not sufficient for the storage of material. As a matter of fact the requirements of Science material will always fall short but the question is of the best utilisation of the material in hand. In this respect I have found by personally visiting 11 laboratories that provision of Almirahas and wall cup-boards for storage is satisfactory. The misuse of chemicals and tear and wear of apparatuses takes place not because of the shortage of Almirahas etc. but because of the shortage of accommodation to keep them. In many schools almirahas having physics apparatuses, chemicals and biological material are placed in the same room which creates difficulty in arranging the material for the practical work.

On account of poor provision of furniture and space, practical work is greatly handicapped. In order to know the cause of poor provision of furniture a question was included in the questionnaire as given on the next page.

Question:- Whom do you hold responsible for ill furnishing and poor provision in your lab ?.

(a) Your ownself (b) Your Principal (c) A.D.P.I.,

(d) Non- Availability of standard quality.

In response to the above question 72% of the lecturers and teachers are of the opinion that the cause of poor provision and ill furnishing is non availability of standard quality. In this region, there is shortage of standard firms which may supply required furniture. The firms which deal in supply of furniture are at district headquarters. They show their unability to supply furniture to the interior schools. Budget for the purchase of furniture etc. is allocated to the Principals of all the Higher Secondary Schools by the A.D.B.H.,. Now it comes to the Principal whether to use the funds for the purchase of science furniture or for other furniture of the school.

Principal in the absence of standards firms for the supply of furniture etc., orders the local dealers to make the required furniture. The furniture supplied by them is not of a standard quality. Thus money is also spent and standard quality is also not available.

Thus after making an analysis of the furnishing of laboratorie it is concluded that laboratories may be placed under different categories with regard to their equipment and maintenance. In order to make a rating scale for the laboratories a question was included in the questionnaire as given below.

Question:- How do you rate your laboratories regarding furniture and other provisions ?.

(a) Well equipped and well maintained.

(b) Well equipped but ill maintained.

(c) Ill equipped but well maintained .

(d) Ill equipped and ill maintained.

The conditions of science laboratories with regard to above ratings are tabulated below.

TABLE No. 8

S.N.	Nature of Category.	No. of schools placed in the category.	Percentage.
1.	Well equipped and well maintained.	9	20.4
2.	Well equipped ~~and~~ but ill maintained.	Nil	Zero
3.	Ill equipped but well maintained.	31	70.4
4.	Ill equipped and ill maintained.	4	9.2

From the table it appears that 20% schools are having laboratories which are well equipped and well maintained. Out of these 20% schools most of the schools are from the urban areas. The laboratories of the district headquarters are also well equipped and well maintained. So far as the availability of standard quality of furniture is considered, it is easily available in urban areas and not so in rural areas. That is the reason, the laboratories of rural schools are facing a problem for the maintanance of laboratory.

The number of laboratories placed under category No.2 is zero. The maintenance of laboratories depend on the incharge of the different laboratories. They do not want to show their inefficiency by disclosing the facts that laboratories are well equipped xxx but ill maintained.

From the table above it is found that 70% laboratories are ill equipped but well maintained. Out of these 70% laboratories 25% are of such schools which have directly been raised from Jnior High School to Higher Secondary Schools. The requirements of furniture etc., can certainly not be fulfilled in such schools with in such a short period. Out of the remaining ones, some laboratories belong to rural areas. They can not get the standard qualify of furniture till they xx approach standard firms which are at for off places. More over the fulfillment of Science requirements mainly depends upon the Principal of the school who is finally responsible for the allocation of budget to different sections. A Principal who is interested in the teaching of science will always try to allocate more funds to science section.

Nine percent laboratories are in the category of ill - equipped and ill maintained. These nine percent schools are out of those schools which are falling short of science teaching staff. In the absence of the suitable number of Lecturers and teachers in the school, the maintenance of laboratories becomes difficult.

In this chapter conditions of science laboratories with regard to building and furniture have been discussed. Discussion is based on the ~~fi~~ informations collected through questionnairs. The reliability of the facts is to be taken within the limits of questionnaire method. Personal experience and observation have also been taken into consideration while discussing the various aspects of laboratory provisions and the problems arising thereof. In the discussion where actual numbers are quoted they refer to this sample only and in view of its small size they should be treated with due caution.

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CHAPTER - V

LABORATORY PERSONNELS

In the previous Chapter the conditions of science laboratories with regard to Building, Furniture and Other fittings have been discussed. Now in this Chapter the condtiions of science laboratories with regard to laboratory personnels will be discussed.

The term laboratory personnels includes the teaching staff as well as the staff provided for the laboratory assistance, Laboratories and the apparatus in them need skilled and careful maintenance. Although the ultimate responsibility for this care lies with the teacher who is incharge of a particular laboratory, but it is not the only responsibility of him. He can not discharge his this responsibility well without assistance.

Lecturers and Teachers:-

In order to know the strength of teaching staff for science in the schools, a question was included in the questionnaire.

Question:- Please mention here the teaching staff for science subjects in your school.

	Lecturers	Teachers
1. Physics	-	-
2. Chemistry	-	-
3. Biology	-	-

From the informations gathered in connection with this question it is concluded that one Lecturer for each subjects (Physics and Chemistry) has been provided by the Government. Biology Lecturer has been provided in the schools whose biology is taught. In the schools where number of students offering science is large, some science teachers have also been provided.

It has already been stated in Chapter IV table no. 1 that 47% of the schools justify their recognition of science subjects because of the provision of sufficient number of lecturers and teachers. It has also been concluded from the question above that in certain schools where the number of science students is comparatively lower than the other schools, the science teaching staff provided in such schools is more than those other schools. The institutions having sufficient number of students offering science subjects should compulsorily be equipped with suitable staff.

Duties and Responsibilities:-

These lecturers and teachers of the schools are finally responsible for the science equipments. Over and above the normal teaching and practical work, they also hold the charge of laboratories. In the schools where teaching staff is short, one teacher has to hold the charge of more than one laboratory.

In order to know the position of science laboratories in this respect, a question was included in the questionnaire.

Question:- Is there a separate lab. incharge for Physics, Chemistry and Biology ?.

From the responses received it is concluded that schools having separate laboratories are providing separate lab.incharge.

While giving the charge of a laboratory to a particular person the consideration is given to seniority in service as science teacher. When one teacher holds the charge of more than one laboratory, there comes the difficulty of arrangement in the practical work. A teacher teaching a subject but not holding the charge of the laboratory of that particular subject, can not guide his students in practical and demonstration work effectively

Teachers of science have to discharge a number of responsibilities. In order to know the nature of the work done by the lecturers and teachers, a question was included in the questionnaire.

Question:- What is the nature of the work taken by the following Lab. personnels provided in your schools ?.

Lecturer/Teacher	Lab. Asstt.	Lab. Attendant.
1. Maintaining stores and stock accounts	1. Maintaining records of breakages & consumption.	1. Maintaining neatness & cleanliness of lab.
2. Purchasing of Sc. material.	2. Issuing articles to students.	2. Cleaning the apparatuses.
3. Conducting the practicals	3. Helping the students in practical work.	3. Looking after the lab.
4. Others	4. Helping the teacher in adjusting faulty apparatuses.	4. -
5. -	5. Any other	5. -

It has been concluded from the responses received with regard to this question that lecturers and teachers have to do all the duties as assigned above. They have also to perform the duties of Lab. Asstt. and Lab. Attendants.

Laboratory Assistant and Laboratory Attendants:-

The provision of Lab. Asstt.and Lab. Attendants in the Higher Secondary schools of this region is very meagre. During my personal visits to laboratories, I found that teachers of

science are overburdened with the work. The efficiency of the practical work is duly hampered in the absence of lab. asstt. One Lab. Asstt. has been provided to the schools of the district headquarters and others are not even provided with the Lab.Attendant.

In order to know the requirements of Lab. Assistants and Lab. Attendants by the schools, a question was included in the questionnaire.

Question:- What are your requirements regarding personnels ?.

	Lecuturers.	Teachers.	Lab. Assistants.	Lab.Attendant
1. Physics	-	-	-	-
2. Chemistry	-	-	-	-
3. Biology	-	-	-	-

From the requirements given by the various schools it is concluded that on average every school requires one Lab.Assistant for all science laboratories and every school requires one Lab. Attendant for each science laboratory. Govt. has started taking steps in the direction of providing lab. Attendants. Recently, information in connection with the requirement of Lab. Attendants, has been gathered by office of Assistant Director of Public - Instructions, Eastern Section, Madhya Pradesh, Rewa. One Lab. attendant is to be provided for every 200 students in the school according to the formula given by that office. Of course, this step taken by the Government of Madhya Pradesh will be greatly helpful in improving the conditions of science laboratories.

As regards, the provision of Lab. Assistants, steps are being taken by the Government in this direction. According to the draft standard Pattern for every Higher Secondary School prescribed by the Director of Public Instructions, Madhya Pradesh, One Lab. Asstt.

of a trained graduate scale is to be provided to every school having science courses. All these schemes when implemented will be greatly helpful to the cause of teaching science at secondary stage in this region.

At present, meagre provision of lab. attendants and lab. assistants given to some institutions is of very low quality. Teachers of the schools where they are provided, have expressed that they are unable to discharge satisfactorily any of the duties assigned to them. Some of the teachers have stated that lab. attendants provided do not even recognise the science material. To take work in science laboratories from such raw staff is also very risky. A question was included in the questionnaire to know the ways to improve the efficiency of the lab. personnels.

Question:- What steps should be taken to improve the efficiency of Lab. personnels ?.

(a) Special training should be given to them.

(b) Only qualified and experienced staff should be appointed.

(d) Any other.

It has been suggested by science lecturers and teachers that only the persons holding some special qualification or training regarding maintenance of laboratories should be appointed as Lab. Attendants. Some of the teachers have stated in the q questionnaire that laboratory attendants must be at least matriculate in science with some special training.

Their duties and responsibilitie is:-

These assistants should not only be expected to do routine cleaning of apparatus which may be undertaken by students as part of their laboratory training. As regards the setting up of apparatuses for demonstration, that may also best be done by

teachers themselves. Help should be taken from them according to their abilities and training such as the following tasks.

* * " 1. Making new apperatus in connection with the teaching staff.

2. Maintaining in good working order the science rooms, their furniture and services. Part of this duty would be carried out when the school was not in session.

3. Checking and replenishing sets of apperatus.

4. Storing apperatus in proper manner.

5. Keeping a stock book, and recording routine requirements.

6. Preparing stock soloutions, maintaining an adequate supply of distilled water.

7. Setting up simple standard assemblages of apparatus.

8. Putting out and collecting some apparatuses for class use

9. Repairing faulty apparatus.

10. Cleaning out Cup-Boards and stores periodically.

11. Maintaining such long-term experiments and demonstrations as might properly be assigned to them instead of to pupils.

It is clear, that in order to carry out this work, a laboratory technician must be provided with necessary tools and must have his working place near store and teaching rooms.

It is essential that laboratory personnels should be given proper training & this cannot be under taken only by sc.staffs, they need to attend specially designed courses of instruction. No such courses are conducted in the state at present. But provision for it must be made. Lab.personnels must have some prescribed qualifications & there should be avenues of promotion for them.

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* Science in Secondary Schools, Ministry of Education London.

CHAPTER - VI.

CHEMICALS, APPARATUSES AND THEIR UP KEEP.

In the previous chapter a discussion about the laboratory personnels has been given. In this chapter an investigation into preservation, storage, consumption, purchase and recording of science material will be made. This is also an important aspect of science laboratories.

1. Preservation and storage:-

Science material consists of costly apparatuses and chemicals of different properties. Special attention should be given to their preservation and storage. In Chapter IV while discussing the problem of building for the science laboratories emphasis has been given on the separate store room for physics, chemistry and biological laboratories. As already investigated in that chapter our laboratories are at present lacking in that respect. Sufficient number of Almirahas and Wall-cup boards is also needed for the preservation of science material. As discussed under furniture in chapter IV, it is appreciable, that our laboratories are provided with the number of almirahas and Wall-cup-boards which is to a great extent sufficient for preservation and storage. Yet there are some technical considerations to be taken into account as regards storage of science material.

A question was included in this respect in the questionnaire as given below:

Question:- Have you adopted any system of classification in storing of apparatuses used in your lab ?. Yes/ No

TABLE No. 1.

S.No.	Number of schools having a definite system of classification.	Number of schools having no system of classificatio
1.	44	Nil

It is clear that all the schools in the sample have adopted some system of classification in storing of apparatuses used. Further, in order to know the type of the classifications one more question was added in continuation with the above question.

Question:- What sort of classification is adopted for storing of apparatuses in your lab ?.

1. -

2. -

3. -

From the responses it is clear that generally two types of classifications incase of storing physics apparatuses are being followed.

I. Type:-

(i) Permanent Apparatuses

(ii) Breakable Apparatuses (Glass material)

(iii) Consumable normally with in two or three years.

II. Type :-

Classification of apparatuses in storing is done according to sections in physics as-

(i) Apparatuses concerning General Properties of matter.

(ii) " " Heat.

(iii) Apparatuses concerning Light.
(iv) " " Electricity.
(v) " " Magnetism.
(vi) " " Sound.

Number of schools using two types of classifications as given above is tabulated in the following table:-

TABLE No. 2.

S.No.	No. of Schools using I type of classification.	No. of schools using II type of classification.
1.	7	32

In the sample 5 institutions have not stated the system of classification they follow. From the table given above it is revealed that majority of the schools are following II type of classification in storing apparatuses. Every system has its own advantages and disadvantages. But second type of classification is more suitable. It will be still better if separate Almirahas are used for separate sections of physics. The care should be taken that apparatuses which are to be affected by one another should be kept away. For example magnetic substances should be kept away from apparatuses like Ammeters, Tangent Galvanometers which have got metallic parts. Delicate apparatuses like Fortin's Barometer should be stored in proper cases as they are easily to be damaged.

Classification of chemicals is also desirable in storing them in the laboratories. In order to know the types of classification used by the schools, a question was included in the questionnaire.

Question:- Do you follow any classification in case of chemicals ?

Yes/ No

TABLE No. 3.

S.No.	No.of schools following some classification.	No.of schools following no classification.
1.	40	4

From the table it is revealed that 89% schools in the sample are following classification in the storing of chemicals. In order to know the details of the classification a question in continuation with the above one was included in the questionnaire.

Question:- If yes, please give the details of classification ?

1. - -
2. - -
3. - -

The number of the schools and the types of classifications followed by them are given below:-

1. Six schools have adopted ~~in~~ the following classification in case of chemicals.
   (a) Acids and Alkalies
   (b) Other liquid chemicals
   (c) Powder type and crystal form chemicals
   (d) Apparatuses. (Glass)
2. Five schools have adopted ~~in~~ alphabetical order in the classification of chemicals.
3. Five schools have adopted the following system of classification
   (a) Organic
   (b) Inorganic
   (c) Chemicals used for daily consumption.

4. Eight schools have adopted the following system of classification.

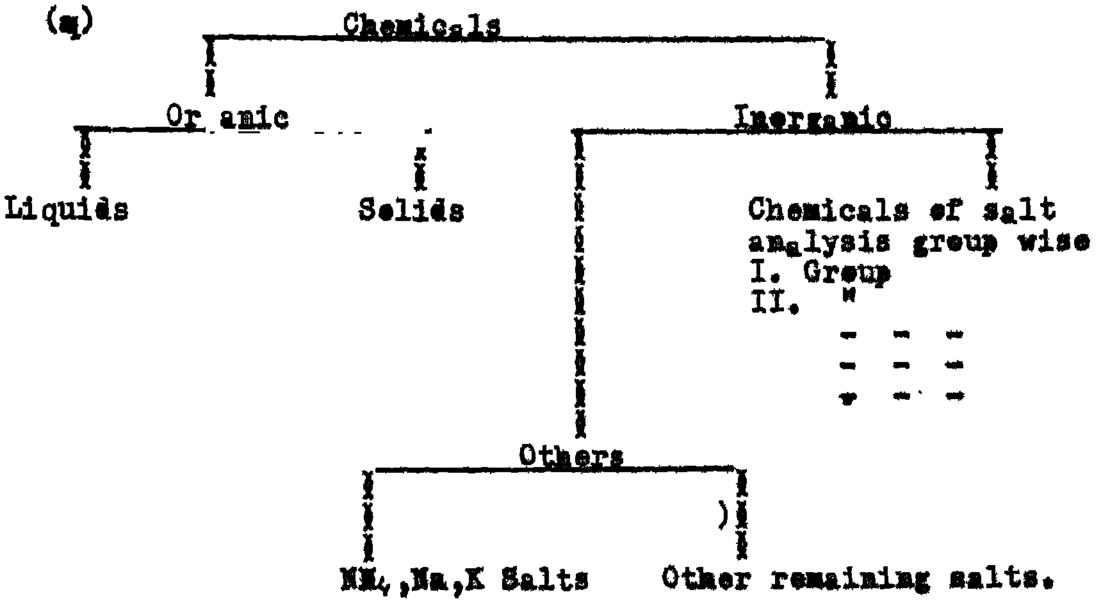
(a) Acids separate

(b) Other chemicals in Alphabetical order

(c) Glass material.

5. Sixteen schools in the sample have adopted following system of classification.

(a)



(b) Acids separate.

Thus five types of classifications in case of chemicals are being followed by different institutions. Out of these five types of classifications, V is followed in majority of the institutions. This classification appears to be better than other classification Storage of chemicals on account of their specific properties always require much caution and care. There are certain chemicals like silver nitrate etc. which get decomposed on exposure to light. Such chemicals should always be stored in coloured bottles.

There are others which are explosives particularly when temperature is high, such chemicals should always be stored in cool places.

8 It will always be better to store Acids separately. Acids are mostly fuming particularly Nitric Acid which also affect other chemicals placed near it. Acids are also reactive to wooden or metal pots. Their preservation in wooden or metallic Almirahas is not very favourable. Acid proof Almirahas may be used for the preservation of Acids. In the secondary schools of England separate room is used for the storage of acids. This room is built of acid proof material.

2.Consumption and Breakage:-

Apparatuses stored in Physics laboratories are generally of permanent nature. Their consumption is out of question. But the chemicals stored in chemistry laboratories are all of consumable nature. The possibilities of breakage are apparent in physics, chemistry and biological laboratories. Glass material is used for practical work in all the three sciences.

In some of the laboratories the system of issuing the apparatuses to the students for whole of the session is used. The possibilities of breakage as depends mostly upon the way the apparatuses are issued to individual students and handled by them. In order to know the ways of issuing material to the students, a question was included in the questionnaire as below:-

Question:- What is the system of issuing apparatuses and other articles to students ?.

(a) Individuals are issued every thing in the same period before they carry on the work.

(b) Articles of common use are issued to them for whole of the session.

(c) Seats are well equipped before hand with required apparatuses.

(d) There is no system of issuing the articles.

TABLE No. 4.

S.No.	Type of system of issuing the articles.	No. of schools using the system.	Percentage.
1.	Individuals issued every thing in the same period.	21	47.7
2.	Articles of common use issued for whole of the session.	8	18.1
3.	Seats are well equipped before hand.	15	34.2

In 18% schools, articles of common used are issued to students for whole of the session. In 47% of the schools individuals are issued every thing in the seame period. While doing practical work in Higher Secondary classes, students are required to handle costly apparatuses. Therefore, it will always be safe to get some money deposited from them in the form of caution money and at the end of the session, breakage charges if any, may be deducted from the caution money. Particularly when in 34% of the schools, the seats are left well equipped before hand, there is possibility of the apparatuses being broken or stolen by the students.

In order to know, if there is any system of caution money to be realised by the student, a question was included in the questionnaire.

Question:- Is there any provision for caution money to be realised by the students using lab. ?.

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In response to this question it has been disclosed that the system of ~~xxxxxxxxx~~ realising caution money by students is not in practice in this region. As a matter of fact such realisation can not be made in the absence of proper order from the Govt. Therefore, it may be proposed that steps may be taken by the Govt. to ~~xxx~~ impose caution money which will be helpful in checking the breakages.

It has also been noticed in response to the question on realisation of breakage fee by students that realisation of breakage fee by students is also not in practice in this region. During my visits to one of the science laboratory the Lecturer incharge of laboratory told me that he once charged breakage fee from a student but that was objected to by the Principal. Therefore in case of breakages, either the material is replaced by the students himself or the proposal is put before the Principal for writing off the broken article. It is my personal experience that Principals do not agree to write off the material. Therefore, some times it results in to the strained relationship between the Principal and Lab. Incharge. The power of writing off costly material is in the hands of A.D.P.I who seldom agrees to write off the material. In this way breakage is definitely a problem for the lab. incharge.

Now let us have an insight into the consumtion of material. It is a matter of routine that consumed material should be verified by the Principal. A question was included in the questionnaire regarding verification of consumed material by the Principal.

In the sample 80% lecturers and teachers of science have stated that they do not find any difficulty in verification of consumed material by the Principal.

From the above table it is evident that A.D.P.I is not responsible for purchase. 72% of the schools have expressed that the responsibility of purchase lies with the Principal. There are a few schools who are having purchasing committee including members of the staff. But the condition of purchasing committee is not very sound. Some of the schools have revealed that purchasing committee is only nominal and Principal is the Convener of the committee and as a matter of fact, he is the dictator in this respect.

From the informations gathered personally by me during my visits to certain laboratories, I found that the purchases are made in the schools on tender basis. But the system of accepting the lowest tender is in general practice. As a matter of fact emphasis should be given more on quality of material to be purchased and not on the low price. Particularly in science where, apparatuses if not of standard quality will fail to give accurate results in practical and demonstration.

While making a purchase of science material in any school, the teacher of science must be consulted regarding its quality. This practice is continued in the schools where Principal is responsible for purchase. Principalsdo take consultations from science incharge, then only final orders are placed.

The difficulty in purchasing science material of standard quality also arises due to absence of catalogues of standard firms. A list of standard firms dealing in the science material be prepared by the Govt. and may be sent to every Higher Secondary School. This will help in getting material of standard quality. Higher Secondary schools situated in the most interior places do not get the catalogues of standard firms.

It depends upon the particular Principal to verify or not to verify the consumed material. During my visits to laboratories in one school, I was told that Principal did not agree to verify the consumption of one bottle of sprit. Though such cases are very rare, yet difficulties do arise some times.

This is the picture of the consumption and breakage problems in the Higher Secondary Schools of this region.

3. Purchase:-

Purchase of furniture or of equipment is also one of the important aspect. Generally the system of purchase in this region is as given below.

Fixed amount in the budget of the session is allotted by A.D.P.I. to the Principals of Higher Secondary Schools. The Principals are mostly responsible for the purchases of science material. In order to know the position of the schools in this respect, a question was included in the questionnaire as below:-

Question:- Who is responsible for the purchase of laboratory requirements ?

(a) A.D.P.I. (b) Principal (c) Body of teachers

(d) Science teacher who is incharge of Lab.

TABLE No. 5

S.No.	Person Responsible for purchase.	No. of schools.	Percentage.
1.	A.D.P.I	-	-
2.	Principal	32	72.7
3.	Body of teachers	7	16.0
4.	Science teacher who is incharge of lab.	5	11.5

During the course of conducting practical examinations in different schools of this region, I personally felt that the material at present in stock of science laboratories is not of standard quality. In order to know real condition in this respect, a question was included in the questionnaire as below.

Question:- Are you satisfied with the quality of material in your lab ?.

Nearly 57% of the schools are of the opinion that material is not of standard quality. Further, in order to know the cuase of this low quality, a question in continuation to the above question was included in the questionnaire.

Question:- If 'no', whom do you think to be responsible for the low quality ?.

(a) Your own self (b) Principal

(c) Lack of avilability of good quality

(d) Any other.

Responses given by 57% of the schools in reply to the above question are tabulated below.

TABLE No. 6

S.N.)	Who is responsible	No. of schools holding responsible.	Percentage
1.	Your own self	-	-
2.	Principal	-	-
3.	Lack of availability of good quality.	16	36.3
4.	Financial shortage	9	20.4

Out of 57% of schools having low quality of material 36% are of the opinion that quality of material is low on account of lack of availability of good quality. 20% are of the view that quality is low because of the financial shortage. As a matter of fact, both the factors come to rest upon financial shortage. If, funds are at disposal in sufficient quantity, even the best material can be purchased.

Improvement in quality:-

A question was included in the questionnaire in order to know the opinions of the teachers regarding the ways for improvement in quality of material.

Question:- How can the quality be improved ?.

(a) Purchase should be made from the standard firms.

(b) Science incharge should be responsible for final orders

(c) Material should be supplied directly by the Govt.

(d) Any other.

From the responses received, it is concluded that majority of the schools are in favour of the following suggestions.

1. Purchases should be made from standard firms.

2. Science incharge should be responsible for final orders.

3. A body of teachers should be consulted before making the purchases.

Out of the three suggestions given above, number two is of course of practical utility. The final responsibility of purchase must go in hands of science incharge who has to deal with the material purchased.

4. RECORDING:-

To have a complete record of the material purchased, consumed or broken is also one of the most important aspect in the conduct of laboratory. This may be possible only when proper registers are maintained for it. In order to know different types of registers maintained by the schools, following question was included in the questionnaire.

Question:- What are the different registers that you maintain in your lab. ?.

(a) Stock Register.

(b) Breakage Register.

(c) Consumable material register.

TABLE No. 7.

TABLE SHOWING THE RECORD OF REGISTERS MAINTAINED BY THE SCHOOLS

S.No.	Name of Register	No.of Schools	Percentage.
1.	Stock Register	44	100
2.	Breakage Register	30	68.1
3.	Consumeable Material Register.	39	87.7

From the table it is concluded that all the schools are maintaining stock register in their laboratories. There are only a few schools which do not maintain Breakage and Consumeable register. On investigation, it is found that these schools are the schools having small number of students. So the problem of

consumption and breakage might not be coming to them. Maintainance of all these registers separately is essential in order to have a complete knowledge of stock in hand, having no consideration for the number of students.

No doubt, stock registers are being maintained by all the schools but their form differs from school to school. There is no uniformity in this respect. A question was included in the questionnaire regarding information about the entries and columns made in the stock registers used. Only 20% of the schools have responded to this question. From these responses, it has been concluded that columns in stock registers differ from place to place. As a matter of fact there should be uniformity in the maintenance of registers in all the schools for a thorough checking when required. All the schools of the region being controlled by the Govt. must have uniformity in this respect.

Entries made in the stock register and other registers must be countersigned by the Principal. In order to know the actual position in this respect a question was included in the questionnaire as given below:-

Question. Are the entries duly countersigned by the Principal ?

% In response to this question 82% schools have replied that the entries are duly countersigned by the Principals. Maintenance of consumption and breakage registers as already revealed is done in 39 and 50 schools of the sample respectively. The entries of consumption and breakage registers are verified by the Principals. In order to have a clear position of the stock in hand and its checking by the Principal as well as by the Lab. incharge is essential. A question was included in the questionnaire to know the system of stock checking.

Question:-

(a) How often is the stock checked by you ?

Weekly/ Monthly/ Yearly.

(b) How often should it be checked by you ?

(c) How often is it checked by the Principal ?

(d) How often should it be checked by the Principal. ?.

The responses received in this connection are given in the table below.

TABLE No.8

S.No.	Nature of Checking done by the Principal.	No.of Schools.	Percentage.	Nature of Checking done by Lab. incharge.	No.of Schools	Percentage.
1.	Weekly	-	-	Weekly	-	-
2.	Monthly	-	-	Monthly	8	18.1
3.	Yearly	39	88.6	Yearly	36	81.9
4.	Never	5	11.4	Never	-	-

TABLE No.9

S.No.	Nature of Checking should be done by the Principal.	No.of Schools.	Percentage.	Nature of checking should be done by Lab incharge.	No.of schools	Percentage.
1.	Weekly	-	-	Weekly	-	-
2.	Monthly	21	47.7	Monthly	19	43.1
3.	Yearly	23	52.3	Yearly	25	56.9
4.	Never	-	-	Never	-	-

From the tables given above it is revealed that in 88% schools annual stock checking is done by the Principals. As a matter of routine stock checking is not done directly by the Principals but Principals appoint some teacher other than the incharge of a particular laboratory and he, on behalf of the Principal checks the stock in science. After words the counter-signatures of the Principals are obtained on the checking register.

Further, the opinions of the lecturers and teachers were sought on the nature of checking as it should be done by the Principals and teachers. It has been found that 52% of the schools are in favour of yearly checking by the Principals and 56% schools are in favour of yearly checking by the incharge of Labs. Remaining schools are in favour of monthly checking of the stock. As I have experienced monthly checking of the stock may not be possible for lecturers and teachers. Therefore incharge of labs should enter on their register, monthly record of consumption and breakage which may be tallied with the balance in hand at the end of the session i.e. at the time of Annual Stock verification.

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CHAPTER VII

Finances

In the previous Chapters conditions of Science laboratorie in the Higher Secondary Schools of this region in their various aspects like, building, furniture, Lab-personnels etc. have been analysed. As a matter of fact solution of the problem in hand depends mainly upon the finances that are available for the laboratory provisions in various aspects. Ideal conditions to be achieved require a heavy financial provision. Under the present set up of education in this region the whole responsibility of providing facilities for science teaching is of the Govt. Free education is being imparted in this region upto Higher Secondary Classes. No tution fee is charged by the students. Only following sources of income are available in the schools to meet the requirements in science.

(I) Science fees by students.

(II) Breakage charges by students, to replace the things demaged.

(III) Grants by Government. (Amount appropriated for the science section by the Principal out of the total budget sanctioned by the Government.).

(a) Recurring.

(b) Non-Recurring.

In this region no science fee is imposed on the students offering science subjects. So the question of income through science fees totally vanishes. Now the other source of income may be that of the breakage charges realised by the students. In order to know the position of schools in respect of realising

breakage charges a question was included in the questionnaire as given below.

Question:- Is any fee charged for breakage by students ?

All the schools have revealed that the system of realising breakage fee by students is also not in practice. Some of the lecturers and teachers told me during my visit to their schools that they tried to charge breakage fee by students but the principals did not agree to that. The system of depositing caution money by science students is also not in practice in this region. All these systems require a proper sanction of the Govt. for their imposition.

Thus there is no provision to meet the emergency demand for science material from these sources in the schools. Now inorder to know the ways of meeting emergency demand of science requirements, a question was included in the questionnaire as noted below.

Question:-Is there any provision to meet emergency demand ?.

In response to the above question 72% of the schools have stated that there is provision of meeting mergency demand. Now in order to know the nature of provision, one more question was included in the questionnaire in the continuation with the above question.

Question :- If yes, what is its nature ?.

(a) It is met from contingency budget.

(b) It is met from student science fee.

(c) Any other.

All the 72% of the schools noted above have stated that such emergency demands are met from the contingency budget.

In this way there is a clear picture of provision of finances for science requirements in the Higher Secondary Schools of this region. All the necessafy requirements are met from the recurring grants given to the schools by the Govt. In the begining of the session a fixed sum is allotted to every Higher Secondary School for the contingency purposes and furniture etc. From this sum, a portion of it is allocated for the science requirements. Emergency requirements if any are also met from this very sum.

Difficulty is that no attention is paid by the Govt. towards the necessities of different institutions while providing budgets to them. As a matter of fact the consideration should be given to the following factors while alloting budgets to different schools.

1. The number of students offering science subjects in the school.

2. The previous equipment in the schools.

On account of the over sight of these factors proper promision of equipment in different schools becomes impossible.

There are some other difficulties noted below which hinde the allotment of budgets by the Principals to the Science section. No consideration is given to the instituions and their needs but a common measure of sanctioning budget is adopted. Factors responsible may be given below.

1. Prejudices of the Principals.

2. Relationship with the Sciencd teacher comes in the way.

3. Cooperation of clerical staff concerned with the budget.

4. Relationship between the principal and the ministerial staff.

Ways in which the money is spent for science requirements

1. Amount appropriated by the Principals.

The amount is spent for following three purposes.

(i) Apparatuses (ii) Chemicals and re-agents.

(iii) Furniture etc.

2. Amount spent from contingencies.

It is spent to meet the immediate needs to the extent of some fixed amount by the department.

3. Science fee and breakage charges.

It is used to replace the things damaged during handling. As a matter of fact two practices are followed. Either the money so realised is deposited in the treasury or it is locally utilised to replace damaged material.

The problem of building of laboratory is of course very important. No provision has been given by the Govt. with regard to building construction for science laboratories. The Govt. of M.P. has now started giving its attention towards construction of science laboratories. Non recurring grant for laboratory constructi has been given to some of the schools in this region. Details of this provision could not be avilable but from the M.P.Gazette it has been found that the grant for the consturction of two science blocks at Maharaja Multipurpose Higher Secondary School,Chhatarpur has been given. This grant is nearly of Rs. 2 lacs. Of course such a heavy grant of money to all the schools of the region is not possible.

But instead of giving heavy grant to one school only, criteria should be to give grants to all the schools of the region to meet their minimum requirements of building.

Money allotted for science requirements in different schools should be used for the following two purposes.

1. The money should be spent for purchasing new requirements of science which are very essential for the practical work.

2. The money should be spent for the repairs of the material already provided in the laboratory.

Thus science teachers should keep in view while giving their requirements that annual budget for science should be divided in two parts.

(I) Replacement.

(II) Long time plan for equipment.

Articles which are of consumable nature must be replaced every year. Further, budget should be spent according to the needs of the laboratory. All the needs may be divided into the following heads.

(i) Needs for demonstration work.

(ii) Needs for lab. work.

(iii) General Laboratory needs such as tools etc.

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PART - III.

CHAPTER - VIII

Suggestions for the improvement of Science laboratories.

In the previous chapters a general descussion about the existing conditions of science laboratories in their various aspects in this region has been given. Suggestions given in this chapter may be helpful in improving the conditions of science laboratories. Suggestions incorporated in this chapter are based on the following three factors.

(i) Suggestions referred in the available literature concerning the subject.

(ii) Suggestions based on my personal experience as a teacher of science.

(iii) Suggestions given by lecturers and teachers of the schools to which questionnaires were served.

An alround and immediate improvement in the existing conditions of science laboratories of this region is not so easy. It is a gradual process. It will take a long time to meet the standard requirements. Therefore, suggestions given in this chapter are of the following two types.

1. Suggestions as per standard requirements for science laboratories of Higher Secondary Schools.

2. Suggestions which can easily be feasible in the present situation depending on local conditions of this region and which may also satisfy the demands on the science labs.

1. Laboratory Building~~is~~. Combined type arrangement.

If ideal conditions are to be taken into consideration every Higher Secondary School recognised for science subjects must have ~~from~~ three separate laboratories equipped for physics, Chemistry and Biology.

But this is not the time of visualising ideal laboratory facilities but, of the facilities that can easily be provided.

As already discussed more than 70% schools of the sample are having combined type of laboratories. The number of students offering science in these schools is not very large. Therefore combined type arrangement may be continued till separate laboratories are not provided. But that arrangement should be able to meet the minimum requirements.

~~Two~~ One plan~~s~~ for combined type laboratories ~~are~~ is attached at the end of this volume. These plans satisfy the minimum requirements of a laboratory. Therefore, it is suggested that combined type arrangement may be based on these plans, making suitable alterations where necessary.

In case accommodation available in the laboratories is not sufficient, as is the case with a large number of laboratories of the region, some temporary arrangement be made to conduct practicals. Shedes of tin or bamboos may be prepared and placed attached with the rooms containing science material. Thus difficulty of practical room and store room being in common can be removed.

Separate Laboratories:-

By the researches made in England given in "Science in secondary schools" Ministry of Education London, Pamphelet No.38, following dimentions have been prescribed for a science practical room.

An accomodation of 960 sq. feet for a laboratory of 30 students is considered to be sufficient.

Ratio of length to breadth as suggested is five to three. So the length and breadth of the practical room should be 40 feet by 24 feet.

In the book "Science teaching " by Hoff size of the practical room has been suggested 22 feet by 40 feet.

In our country too, steps have been taken to standardise the size of the practical rooms. According to the recommendations of the Panel on school building appointed by the Govt. of India Ministry of works, Housing and Supply, following details regarding laboratories building have been given.

"Laboratories shall be planned for even number of students subject to a minimum of 20. The area of laboratory shall be worked out at 20 square feet per student seat provided. A store room 80 to 120 sq. feet may also be provided".

Plans suggested by the panel for physics and chemistry laboratories for 24 students have been attached at the end of this volume.

Demonstration Room:-

Demonstration work can be carried on in laboratory but practical work can not be carried on in demonstration room. So the demonstration room is of secondary importance. When a demonstration room is provided, ample room should be left for demonstration bench. The room itself should have an area of not less than 540 sq. feet. Ample space should be left between the front of the demonstration bench and from row of desks. As already stated it being of secondary importance, arrangement for demonstration work should be made in the practical room. It can be made suitable by making arrangement of suitable furniture. Even if there is no arrangement for it in the practical room, the work may

be carried on in the teaching room. This arrangement will be suitable under the present set of circumstances in this region.

Store Room and Preparation Room:-

Adequate facilities for store room and Preparation room are essential. Particularly in the schools where combined type arrangement of laboratories prevail, a separate store room and preparation room is more important. Practical work of two or three subjects may be carried on in one practical room smoothly only, if there is separate arrangment for storage of apparatuses and chemicals.

Store room and preparation room should be so situated as to have a direction access from each laboratory. In the secondary schools of England, the dimensions of these rooms are at least 10 feet ~~with~~ width and an area of about 250 square feet.

Chemistry laboratory may be provided with a supplementary supply room. It is suggested that this supply room be placed out side the school building because of the danger of fire catching. Before plans be made for constructions of laboratory building these factors should be kept in view.

64- It is also suggested here under the present conditions of laboratories of this region that the storage and supply room may be replaced by making a suitable partition in the single practical room provided. This arrangement will be feasible in the schools of this region where strength is not very high.

Dark Room:-

One dark room for whole science department is sufficient this room should be placed in connection with physics laboratory because it is useful for physics. Chemistry and Biology pupils may also fulfill their occasional demands when required.

* A dark room should be large enough to accommodate from eight to twelve pupils at a time. In order to do this, the dimensions required are approximately 8 by 12 feet with a small vestibule at the entrance to keep out light while going in and out.

In the absence of the dark rooms, work may be done by making a space with the help of curtains as is done in some of the schools at present.

Location of science laboratories:-

In the higher secondary schools of this region no consideration has been given to the location of science laboratories in the school. As revealed in Chapter IV Table No.6, 45% schools are having laboratories as part of the main building but at one end of it and 40% schools are having science laboratories as part of the main building but surrounded by other class rooms.

From the point of view of teaching efficiency, economy and convenience, it is desirable to have all the science laboratories concentrated in one section of the building. If possible, a single wing of the building should be utilised for purpose of science laboratories.

Flexibility :

While planning for the construction of science laboratories maximum amount of flexibility should be allowed in plans for future adjustments, the school may be a large one or a small one.

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* Secondary School Science Teaching By G.Hoff Page 244.

Today, the problem of accommodation in Higher Secondary schools of this region is very acute, Therefore, it is suggested that science laboratories should be so planned as to allow any other subject to be taught there in with comfort to pupil and teacher both. More convenient and economical would be to provide a sufficient number of cabinets in the science laboratory instead of providing separate store and supply room.

2. Furniture and other General specifications:-

Suitable furniture is essential for the successful practical work to be done by the students. Generally ~~three~~ four types of furniture is required in science laboratories.

(i) Furniture required for demonstration work by the teacher.

(ii) Furniture required for practical work done by the students.

(iii) Furniture required for storage of chemicals and apparatuses.

(iv) Special arrangment of furniture for preserving books and practical note books of students and other such material.

In the Higher Secondary Schools of the region as already investigated there is no provision for separate demonstration hall. In the absence of demonstration hall, demonstration work may be carried on in the laboratories. But there must be demonstration tables for that. Demonstration table should be of such a height from which demonstrations may be visible to the students.

The furniture for physics room:-

Ordinarily, four pupil tables are quite adequate for directed study, discussion and experimentation.

These tables, if possible may be connected with gas and water taps. If it is not possible to provide these facilities on every table, a large table may be provided in the room to which these connections may be made.

In schools having small number of students, physics and chemistry class rooms and laboratories may be combined. This may be done quite satisfactorily. The physics room should have an ample supply of instrument and equipment cases with glass doors which can be locked. The glass doors permit display of equipment.

Furniture for Biology Room:-

Biology room should also be equiped with a demonstration table. The remaining tables for pupils may be two or four pupil tables. These tables need not necessarily be connected with water, gas or electricity. An ample supply of glass cases should be available for the purpose of display of mounted specimens of different kinds.

Furniture for Chemistry Room:-

Chemistry room definitely requires a special type of furniture. Tables required for chemistry practical work must be provided with shelves and racks where chemicals for the daily use may be placed. A pattern~~s~~ of the shelves and racks used for the chemistry tables is attached in the end. These tables should also be fitted with gas burners, water taps and sinks.

As a matter of fact schools of our region are particularly lacking in furniture for the use of chemistry laboratories.

Proper allotment of seats to the students is not possible in the absence of standard size chemistry tables which is one of the most important factor for the chemistry pratical. Four students, two on one side and two on the other side may be allowed to work. This will also facilitate the arrangment of chemicals and proper supervision of practical work by the teacher.

A list of standard furniture requirements for physics Chemistry and Biology laboratory each for a Higher Secondary Schools prepared by M/S Shrivastava and Co. Telipura, Sitabaldi, Nagpur 1. is given below.

(Equipment for a class of 40 Pupils)

S.No.	Name	Size	Quantity
1.	Physics and Chemistry practical table	12' x 5' x 3'	6
2.	Biology Practical Table	12' x 2¼' x 2¼'	10
3.	Stools for practical Work	-	50
4.	Store Almirahas with sliding doors	73" x 36" x 10"	5
5.	Counter Almirahas	8' x 7' x 1.4'	5
6.	Almirahas	6' x 4' x 1½'	6
7.	Tables	4' x 3½' x 2½'	6
8.	Notice Board	3' x 2" x 2'	1
9.	Demonstration table	12' x 3' x 3'	1
10.	Chart stand	-	2
11.	Show cases	4' x 2' x 2½'	4
12.	Lecture Theatre furniture as per strength of class		1½
13.	Sinks	-	2 per table

Furniture for storage purposes:-

Shelves and cup boards are essential. These may be distributed between the laboratory and the preparation room. In laboratories it is desirable to have some cup boards fitted with glass fronts. Glass fronted cup boards are also useful for displaying specimen.

A useful size for apparatus cup boards for laboratories is about 7 feet high with a bottom section 1 feet 9 inches deep with wooden doors and a top section 1 foot 3 inches deep, with glass doors. One cup board should be provided with lock and key for the storage of valauable or dangerous material.

Storage of appratus should be made in the cup boards which restrict the accumulation of dust. In our region at present, the number of Higher Secondary Schools being very large, it may not be possible for the government to provide ample furniture for every school. Therefore, it is suggested that suitable projections of stone with cement may be made in the walls where apparatuses which are not very costly may be stored. I found in some schools, the provision of temporary Almirahas in the walls for storage purposes. One most important factor that should be kept in view is that the tables provided in the lab for experimental work may also be used for storage purposes. The under neath portion of these tables may be enclosed with wooden pieces of unused wooden boxes and revetted by nails. This will help in economising the expenditure on furniture. One more point is to be stressed here that the purchase of furniture from standard firms is not possible for every school. Therefore, local dealers may be ordered for the furniture but care should be taken that the furniture made should be of standard size. Out word show should not be given more importance.

Laboratory Personnels:-

As already discussed in Chapter V that the provision of Lab.Assistants and Lab. Attendants in the schools of this region is very meagre. Steps are being taken by the Govt. in this direction. In the questionnaires returned following suggestion was given by the lecturers and teachers of seven schools.

It is suggested that special training courses should be started in the training colleges of the region where persons desirous of taking up this profession may be trained. The minimum qualification for admission to this training should be Higher Secondary Pass with Science.

Till the provision of these lab. assistants is not made, work in the laboratories should be taken by the students offering science subjects. Special preference in internal assessment, should be given to the students offering themselves for the work in over time. It is further proposed that lecturers and teachers holding the charge of labaraterıes may be offered some special allowance for extra responsibility that they are shouldering.

Laboratory assistants and laboratory attendants are two different types of laboratory personnels. From the datas collected through the questionnaires it is concluded that provision of one Lab. Assistant for all the three laboratories in the school and one lab. attendant for each laboratory of science should be made. Some times problems of non cooperation arise amongst lab. personnels where provided. The reason is that their duties are not clearly distinguished. A number of duties as suggested for lab. assistant in the secondary schools of England have been given in Chapter V.

Laboratory Assistants should be responsible for maintaining different records i.e. consumption, Breakage and purchase etc. concerning laboratories. Laboratory attendants should be responsible for maintaining neatness and cleanliness of apparatuses also for placing the material at the proper places.

It is also suggested that in the absence of immediate provision of these laboratory personnels, some contingency servants may be employed for lab. assistance. But strict watch should be kept on them while assigning duties to them as they being quite raw hands, may cause any damage.

Preservation and storage:-

Science material requires special care in its preservation and storage. There are chemicals having different properties as well as apparatuses of different types. Some definite system or classification must be followed while storing them. The matter has been discussed at length in Chapter VI. In the schools of this region classification of apparatuses is followed. But differen systems are followed in different schools of the region. From my experience as a teacher of science I envisage the following scheme for the storage of apparatuses.

Apparatuses in physics may be divided in to three types.

1. Apparatuses used for practical work to be done by individual students.
2. Apparatuses to be used for demonstration purposes in the teaching of science by the teacher.
3. Other apparatuses of permanent nature.

For the successful conduct of laboratory it is essential that little time should be spent in issuing apparatuses to students. One cup Board or Almirah should be reserved for the storage of material used for different experiments. If it is not possible, experiments with all the necessary apparatuses should be arranged on tables. One slip containing material arraged for every experiment~~s~~ should be pasted near the experiment.

Now other almirahas should be used for storage of demonstration apparatuses. These apperatuses may be arranged section wise i.e. heat, light etc. Other remaining apparatuses may be stored in separate almirahs. There are some apparatuses of delicate nature which should be stored in cases and covers.

Similarly chemicals should also be stored following some definite classification. Chemicals to be used for analytical work should be stored in a separate almirah. Re agents to be used for analytical work may be arranged on the tables. If chemistry tables are fitted with shelves and racks, re-agents may be arranged on them other wise, they may be arranged simply on tables in rows. Various types of classification followed by different schools have been discussed in Chapter VI. Among these types, V type is better than other types. Care should be taken while storing the acids. A separate almirah may be used for them. Acids may be stored in big Acid containers and covered a wooden frames for safety.

Consumption and breakage:-

It has already been discussed under Chapter VI that consumption and breakage is ~~difficulty of~~ definitely a problem for lab. incharge.

There is no provision in this region for realisation of breakage charges by students. The system of depositing caution money is also not in practice in this region. But definitely it is a system that consumed material must be verified by head of the Institution and broken material must be written off by head of the Institution. Writing off is not so easily done by the Principals. Limit of writtng off the material by Principals is also not clarified. Following ~~sugg~~ suggestions are given to solve this problem of consumption and breakage.

1. Lab. incharge must be given some power of writing off the articles of some limited value.

2. Realisation of breakage charges by students should be permitted in the schools. The amount so realised should be utilised for replacing the article broken.

3. The system of depositing caution money by students should also be broughtin to practice. The amount to be deposited should be fixed by the Government.

4. Separate Registers should be maintained for consumed and broken material.

The entries of these registers should be Countersigned by the Principals at the end of the session while doing annual stock verification.

Purchase and Recording:-

The system of purchase of science material as already discussed in Chapter VI is uniform in all the schhols of this region. There arises difficulty in purchasing standared quality of material because of the lack of knowledge of standard firms dealing in science material.

It is suggested in this respect that a list of the standard firms be prepared and be sent to science teachers of all the Higher Secondary schools.

It is also some times better to maintain purchase relations with some standard firms and always place orders with them only. In case standard quality is not supplied by these firms, schools will have a chance of complaining with them and warning them for future.

List of minimum requirements for Higher Secondary Schools having science courses is also not with the teachers of science. The steps should be taken in this respect by M.P.Board of Secondary Education, to prepare such lists for all science subjects.

It is also suggested to the Govt. of M.P. that while allocating budgets to different schools, care should be taken to sanction such amounts to new Higher Secondary Schools as to meet their immediate minimum requirements. This will go in a long way to solve the problem of equipment in science laboratories.

The teachers of science should prepare an equipment inventary at the end of the session. This inventory should include the requirements for the next session. The recommendations of the Science teachers should be given priority while sanctioning the purchase of some article even if the cost of articles recommended is higher.

Recording:-

It has been revealed in Chapter VI by the datas collected through the questionnaires that system of maintaining records differs from school to school. As I have observed two systems are in practice in this region for recording the purchase of sc.material

1. In some schools material after purchase is directly handed over to incharge of laboratory and entries are made direct in science stock registers.

2. In some schools a central stock register is maintained by the school office and the material purchased is first entered in that register and then issued to separate departments. Departmental incharge then makes the entries in his stock register.

Second system as given above appears to be better from the point of view of the accounting procedure. It is suggested here that a definite system of recording material purchased should be enforced by the Govt. in all the Higher Secondary schools of this region.

Stock Registers:-

The system of maintaining stock registers also differs from school to school. No definite pettern is in practice. This creates difficulty for the incharge of the section Suppose one science teacher is transferred from one school to another he will have to learn new methods of maintaining stock registers. This creats difficulty at the time of handing or taking over of the charge. Therefore it will always be better if the stock register maintained in diffent schools of the region are of one single pattern.

It happened to me to see the stock register sold by M/S Asa Ram Baldeo Dass & Sons agra which appear to be of much utility in the schools of this region.

Main entries to be made in a stock register of science are given in the form of columns here under.

Stock book of ---------

Name of Article-------------------

S.N.	Date of issue.	Nature of Article with spl. description if any.	Quantity purchased.	Cost. Rs. N.P	Initial of teacher incharge.
1.	2.	3.	4.	5.	6.

Intial of Head of Instituion	Quantity brough forward from perevious year	Total quantity in hand	Quantity consumed	Balance left in stock
7.	8.	9.	10.	11

Initial of person Checking the stock.	Remarks.
12.	13.

One more pattern of stock register as given by Kakkar and Co. Agra, Lucknow and Delhi is given on the next page.

Stock book of-------

Name of article-------

S.N.	Date.	Particulars.	Quantity.	Rate.	Amount.	Issued or consumed	Balance.	Rks.
1.	2.	3.	4.	5.	6.	7.	8.	9.

Maintenance of separate registers for consumption and breakage is also essential. Entries in these registers should be made monthly. At the end of the session these entries in total should be entered in stock register and balance tallied.

In this way this chapter has dealt with the importance suggestions ~~for~~ which can easily be carporated in the schools of this region in the various aspects of laboratories.

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CHAPTER - IX

(Concluding Remarks and scope for further research)

In the previous chapters, my efforts have been to explore the conditions of science laboratories in the Higher Secondary Schools of this region regarding all their aspects. It has also been tried to find out the problems arising there of and giving some practicable measures to solve the problems. This fact is to be taken into consideration that the realiability and validity of the work depends on the size of the sample under examination.

I feel that the problem in hand requires a more intensive study in its various aspects. There had been various factors which stood as a stumbling block in the way and I had to over come them. If the conduct of this work be sponsored by the Govt. it self, much fruitful results can be obtained. As a matter of fact every aspect of the problem in hand requires a study to a greater depth to which I might not have reached.

In the light of the importance of the problem in the present scientific era of education, it will be desirable to suggest here to the govt. that this work may better be done by a panel of experts in the subject. Particularly when very little work has been done in this field of education in this country. I failed to get any previous research work in this subject.

I have tried to view the problem as a single whole which have naturally shortened the field of my approach in the work. Better would be to touch one single aspect of the problem at a time. I have experienced here that the problem can better be studied by analysing it into parts.

For example if the study is made simply about the building for laboratories in Higher Secondary Schools of this region, much truthful results can be achieved.

Study of building condition has been done in chapter III of this work but it is not sufficient in itself, it requires a large supplement to make it complete. I have not done so on account of the little time at disposal and also the limitations of the questionnaire methods. No doubt, I have supplemented the ~~[illegible]~~ field of questionnaires by may personnel visits to laboratories. But the number of laboratories visited was only 11 which appears to be small corresponding to the jurisdiction of study.

It is my personal emphasis that two main aspects, Building and furniture require an immediate attention of the Govt for improvements. In chapter IX, I have cited the various suggesti for the problem. The suggestions are of the following two types.

1. Long term suggestions.
2. Short term suggestions.

At least the short term suggestions can be immediately implemented and long term may be taken onwards in the form of projects.

It will be a matter of great pleasure to me if this work could get due momentum in future. It will be greatly helpful in furthering the cause of science teaching in the Higher - Secondary schools of this region in particular and the State as a whole in general.

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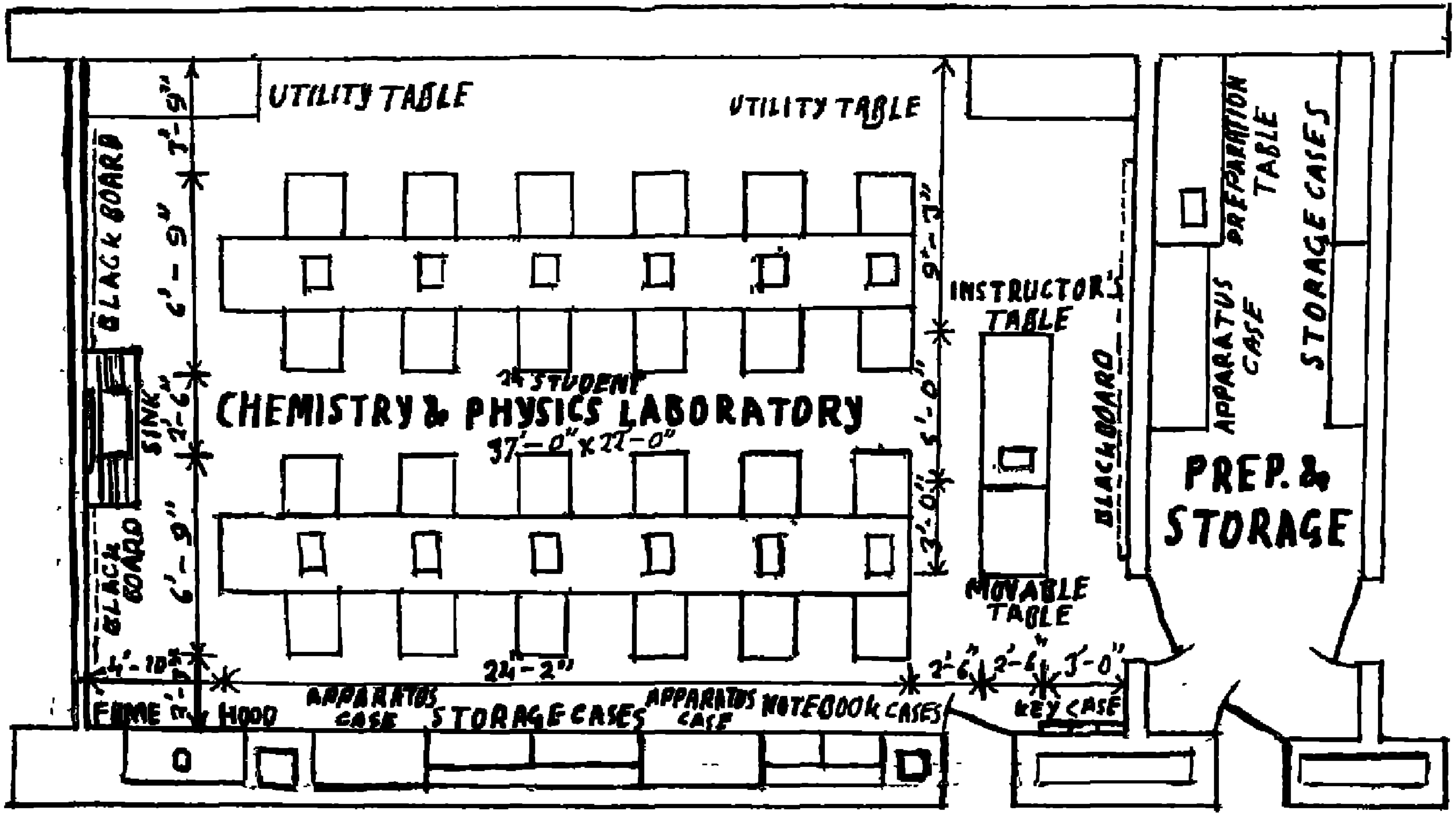
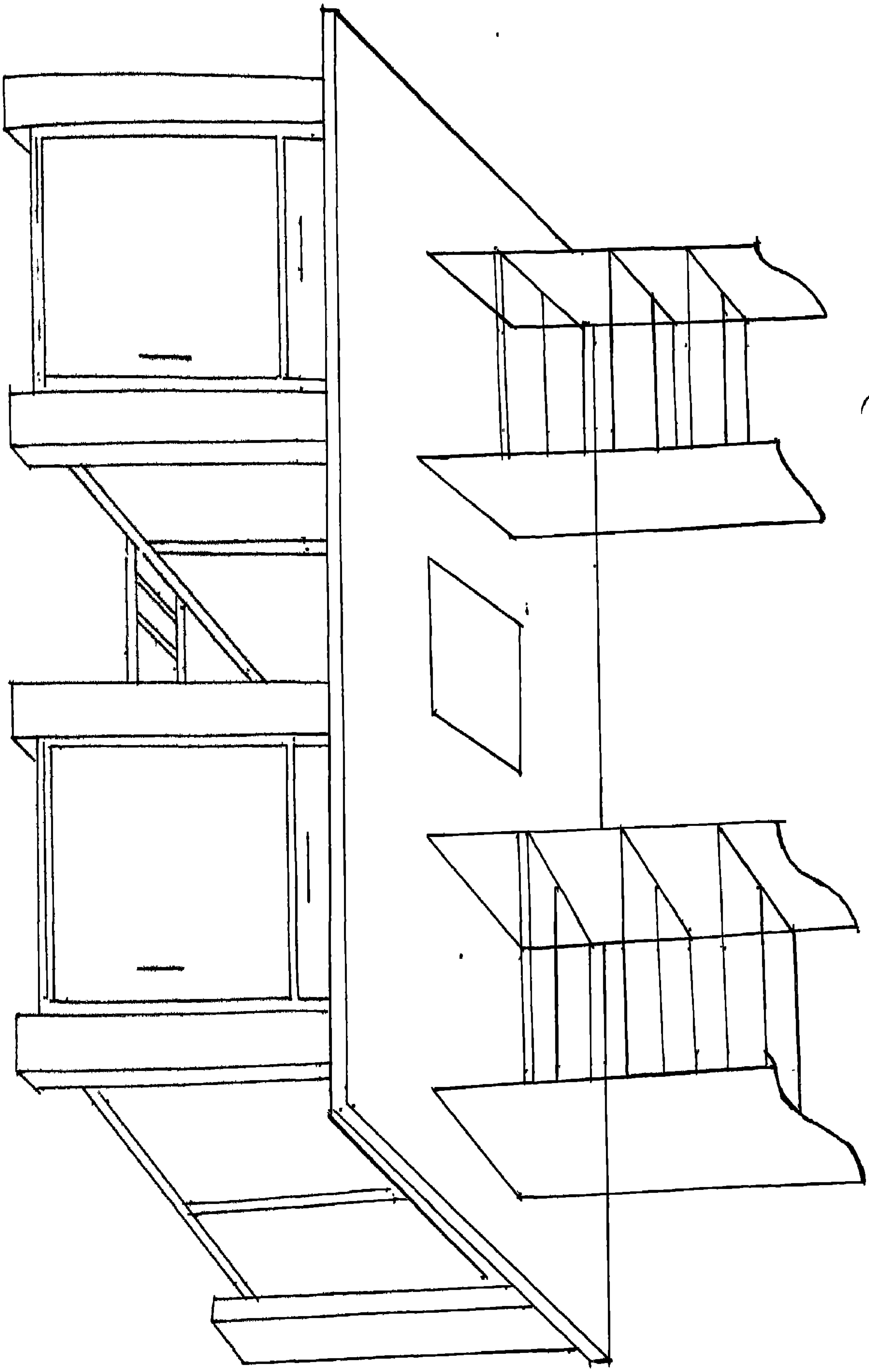


FLOOR PLAN FOR A COMBINATION CHEMISTRY & PHYSICS LABORATORY

Appendix E.



(Furniture for Chemistry lab.)

APPENDIX F

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Appendix 9.

From :-- R.N.Shrivastava M.A. B.Sc., B.Ed.
M.Ed. Student.
Lecturer Govt. Nehru Higher Secondary School
Maharajpur (District- Chhatarpur) M.P.

To,

The Science Lecturer/ Teacher
Govt. H.S. School ______________ District.

Dear Sir/ Madam,

As a student of Science, I have experinced that laboratories play the most important role in the teaching of science in the Higher secondary schools. As such I have taken up " An investigation in to the conditions of science laboratories in the Higher secondary schools of M.P. Region " a topic of dissertation for my M.Ed. examination.

The success of the work depends only on your whole cooperation in it. Hence you are requested to fill in the enclosed questionnaire giving your free and frank opinions in the matter. I assure you that your answer will be~~k~~ kept strictly confidential and be used only for this work.

My guide shri K.L.Chaurasia M.A., M.Ed. will highly appreciate your cooperation in this respect. I shall feel obliged if the questionnaire is completed and returned to me as soon as possible.

Sincerly Yours

Maharajpur

Dated__________1962.

(R.N. Shrivastava)

GRC

Note :- The probable answer to most of the questions have been recorded below the corresponding questions. Please put a check mark (✓) to one which may be applicable in your case or opinion. [illegible] that are not required. In some questions your opinion is required for which blank space has been left to be filled in. In some questions answers are required in the form of Yes or No.

I.---General Information :-

1. Name of your School is ------------------ Block ---------- District ---------

2. Your school was upgraded to Higher Secondary School in the Year----

3. Your school is recognised for Science group:

   (i) With Maths (ii) With Biology

4. In what respect the introduction of science course in your school is justified ?

   (a) There is sufficient number of students offer for this group ----

   (b) You have sufficient of qualified science teachers in school [illegible]

   (c) You have well equipped & maintained laboratories for the science subjects.

5. Please give the number of students offering science subject in different grade.

	IX	X	XI
(a) Maths Group	----	----	----
(b) Biology Group	----	----	----

6. In what year your school was recognised for science subjects ?

   In The Normal Classes [illegible]
   In Higher Secondary [illegible] 19------

II. Laboratory Building :-

1. What is the nature of laboratory provision for Science in your School.

(a)

Separate	Combined
1. Physics	1. All the three.
2. Chemistry	2. Physics & Chemistry
3. Biology	3. Physics & Biology.
	4. Chemistry & Biology.

(b) If combined what difficulties do you face because of this arrangement?

   (i) practical work of your student suffers ---
   (ii) Maintenance of apparatus becomes difficult.
   (iii) Arrangement of practical work in the time table becomes difficult.
   (iv) Any other --

2. What is the nature of accommodation in laboratories of your School?
   (Please put a check mark ____ on the items provided).

3: Is the present provision of Building sufficent to conduct practical conveniently ? Yes / No.

4: What are your additional requirements regarding Building ?
Physics ---------------- Chemistry --------------Biology -----------

5: What is the situation of Laboratory building ?
(a) A separate Laboratory.
(b) Part of main school building but at one end of it .
(c) Part of main building but surrounded by other class rooms.

6: If the laboratories are separate, are they adjacent to eachother or at a far off distance? Adjacent / Far off.

7: What type of problems you are required to face in case you have a single room Laboratory ?
(a) Great risk of chemicals and apparatuses being stolen .
(b) Greater chances of costly and delicate apparatuses being spoiled
(c) Difficulty of explaining the practicals by demonstration.
(d) Development of a tendency to avoid giving practicals and demonstration to students.

8: Is the Laboratory fitted with :------
(a) Water taps ------(b) Sinks, (c) Gas pipe (d) Proper Ventilation
(e) Show Boards (f) Gas Plant ;(g) Electric Supply (h) Fire Extinguisher.

9: What are your suggestions to overcome the problem of accommodation in your Laboratory?
(a) Separate laboratories for all the three subjects.
(b) Each Laboratory to be provided with other rooms as given in question No. 2. Part-II.
(c) Extension in the same Lab. Building be done.
(d) New Lab. Building to constructed.

III.----Furniture and other provision :---

1: Do you purchase the furniture from the local dealers or it is order from standard firm? Local dealers Yes / No.
Standard Firms Yes / No.

2: Do the tables in your Labs satisfy the standard requirement of a well furnished laboratory tables? Yes / No.

3: If not, what are the short comings.
(a) Shelves and racks . (b) Water tapes. (c) Sinks
(d) Gas Burners (e) Others ------------------------

4: If you have a separate demonstration hall in your Lab. is it furnished with following :----
(a) Demonstration Table (b) Chart Stand (c) Notice Board
(d) Show Cases (e) Ventilations and curtains (f) Stair type seating arrangement.

5: Please give the number of almirahs and Wall cup-Boards used for storing of apparatuses and chemicals
Almirahs Wall cup-Boards

8: If not ---- What provision do you make for it ?
(a) Practical work is done only in the final class.
(b) No practical work is done.
(c) Practicals are done by students in batches.
(d) Practicals are arranged in some other room also.

9: How do you rate your laboratories regarding furniture and other provisions ?
(a) Well equipped and well maintained.
(b) well equipped but ill maintained.
(c) Ill equipped but well maintained.
(d) Ill equipped and ill maintained.

10: What is the nature of problem you and your staff have to face because of ill furnished laboratory ?
(a) spoiling of apparatus, chemicals [illegible]
(b) Loss of many apparatus and other [illegible]
(c) any other ------------------------------------

11: Whom do you hold responsible for ill furnishing and poor provision in your lab.
(a) Your own self (b) Your Principal (c) [illegible] lity of standard quality,

12: What measure s should be taken to improve the position in the above respects ?
(a) Immediate Non-recurring grant for the furniture.
(b) Supply of the furniture directly by the Govt.
(c) Any other ----------------------------

IV ---- Mode of using laboratories :--

1: What system have you adopted in your school for the conduct of the practical work in your subject ?
(a) All the three classes ([illegible]) [illegible]
(b) Only the final class does the practical work.
(c) Practical work is done in [illegible] in every class.
(d) Practical work is done after school hours.

2: What are the reasons for [illegible] ?
(a) No other arrangement [illegible] accommodation [illegible]
(b) Negligence on the part of the teacher [illegible]
(c) Shortage of teaching staff and lab attendants

3: Please give the time devoted for the practical work :

	Days in a week	Time allotted per day
1: Physics	----------------	----------------
2: Chemistry	----------------	----------------
3: Biology	----------------	----------------

4: What is the system of issuing apparatuses and other articles to students ?
(a) Individuals are issued every things in the same period before they carry on the work.
(b) Articles in common use are issued to them for whole of the session.
(c) Seats are well equipped before hand with required apparatuses
(d) There is no system of issuing the articles.

5: What precautions do you take to avoid breakages and wastage of chemicals by students.

------ Laboratory Personnels:-

1: Please mention here the teaching staff for science subjects in your school?

	Leactures	Teachers
1: Physics	----------	----------
2: Chemistry	--------	----------
3: Biology	--------	----------

2: Is there a separate Lab. incharge for Physic, Chemistry, and Biology - Yes / No.

3: What considerations are done in giving charge of a lab. to a particular teacher ?
(a) Seniority in service as Science Teacher.
(b) Superiority of grade.
(c) Any other.----------.

4: What is the nature of the work taken by the following lab. personals provide in your school ?

Teacher/ Lecturer	Lab. Astt.	Lab. Attendent.
1: Maintaing Stores & Stock a/c's	1: Maintaing records of Breakages & consumption.	1: Mainteing neatness & Cleanliness of Lab.
2: Purchasing of Sc. material.	2: Issuing articles to students.	2: Cleaning the apparatuses.
3: Conducting practicals.	3. Helping the students in practical work.	3: Lookingafter the Lab.
4: Others------.	4: Helping the Teacher in adjusting faulty apparatuses.	4: Other works.
	5: Any Other.	

5: What kinds of problems your are required to face in dealing with Lab. Assistant and Lab. Attendants ?
(a) They do not cooprate with you.
(b) They do not maintain Science material properly.
(c) There is no cooprration amongst themselves.
(d) Any Other-----------------.

6: What steps should be taken to improve the efficiency of Lab. personnels ?
(a) Special training should be given to them.
(b) Only qualified and experienced staff should be appointed.
(c) Any other ----------------------------

7: What are your requirement regarding personnels ?

	Lecturers	Trs.	Lab. Astt.	Lab Attendent
1: Physics	----------	------	--------	------------
2: Chemistry	--------	------	--------	------------
	--------	------	--------	------------

-Etc.

VI-----

1: Classifiction in storing of appar--. ----Yes / No.

-apparatuses.

5: How do you rate your Lab. with regard to apparatuses and Ch
(1) Well equipped with suitable apparatuses and chemicals .
(2) Ill equiped with suitable apparatuses and Chemicals.
(3) Eqipped with unsuitable and unservicable apparatuses and Chemicals.

VII -------Consumption and Breakage.

1: Is there any provision for caution money to be realised by students using Lab.? Yes / No

2: Is any fee charged for breakage by students ? Yes /

3: Who among the following are authorised for writing off bro material ?
(a) Lab incharge.
(b) Principal of School
(c) Inspectorial Staff.
(d) Others-----,

4: What type of problem you are required to face regarding con ption and breakage ?
1. -------
2:--------

5: Is there any difficulty in verification of the consumed by Head of the Institution ? Yes / NO

VIII------- Purchase .

1: Who is responsible for the purchase of Lab. requirements ?
(a) A.D.P.I. (b) Principal (c) Body of Teachers
(d) Science Teachers who incharge of Lab.

2: Are you satisfied with quality of material in your Lab? Yes

3: If NO whom do you think to be responsible for the low quali
(a) Your ownself (b) Principal (c) Lack of availabilit good quality in market (d) Any other ....

4: How can the quality be improved ?
(a) Purchases should be made from the standard firms .
(b) Science incharge should be responsible for final orders.
(c) Material should be supplied directly by the Govt.
(d) Any other .....

5: Is there any provision to meet emergency demand ? Yes /

6: If Yes - What is its nature ?
(a) It is met from contingency budgets.
(b) It is met from students Science fee.
(c) Any other.

IX ------- Recording .

1: What are the different registers that you maintain in your
(a) Stock registers
(b) Breakage registers,
(c) Consumable material register.

2: What are the enteries made in the stock register ?
(Please give here the important columns .)
1: ----- 2: --------- 3:---------- 4:-------- etc.

Acc. No. R...15596
Date.......23./IX/84........

4: Are the entries duly countersigned by the Principal ? Yes/ No

5: When do you record the consumption and breakage ?
Daily / Weekly / Monthly .

6: (a)How often is the stock of your Lab. checked by you?
Weekly / Monthly / ---------.
(b) How often should it be checked by you ? ------------.
(c) How often is it checked by the Principal? ------.
(d) How often should it be checked by the Principal ?------

7: Are you provided with adequate catalogues of standard firms of science material ? Yes / NO.

ggestions :-- Please mention below your own suggestions for improvement of existing Laboratory conditions

Signature :—
Designation :—